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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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THE FOURTH ANNUAL MEETING OF THE AMERICAN GAS-LIGHT ASSOCIATION.

On the 18th and 19th of last month the Fourth Annual Meeting of the American Gas-Light Association was held at Chickering Hall, in this city.

It was well-attended, there being about 100 members present. We commence to-day to publish the proceedings in full which, no doubt, will be read with interest by all having the true welfare of the Association at heart. The meeting was considered a decided success by those present, and its proceedings will compare very favorably with any held previously. One or two very important resolutions were presented by the Executive Committee, and adopted unanimously. One of them was to relieve the Association, as a body, from the reputation or appearance of a "junketing affair," and was to the effect that the Association, as such, would not accept of any hospitalities at this, or any future, meeting. This is a step in the right direction. A body composed, as this is, of representatives from all parts of the country, many of whom must necessarily have ravelled long distances to attend the meeting, meets for *business* of a most important character. While one of the objects of the society is social intercourse among its members, to the end that they may become better acquainted with each other, still the main, and the most important object, is mutual improvement and a better knowledge of the principles and practice which guide the management of the very important interest committed to the charge of the men constituting the body of gas managers of America.

In an Association which is as wide spread in its membership as this is, it is not expected that every man shall have the time, even if he had the disposition, to take part in the discussions; but there are none so far advanced that they may not learn something from others; and when it is understood that the meetings are held for business purposes, and not expressly for having a "good time," the character of the proceedings is very likely to improve from year to year, for the members will come prepared to attend to business, and their minds will not be preoccupied with what may transpire at the dinner, or other entertainment, which is to be had at the expense of somebody else than themselves.

The other resolution was with reference to patented rights or processes—and was to the effect that there should be no discussion thereof, unless the matter should be submitted to the Executive Committee, in writing, and approved by them.

We are aware that this is a delicate point, but believe that the action of the Association in this regard was both wise and judicious.

We will yield the palm to none in the advocacy of all real and true improvements in any of the various branches of the Science of Gas Making; but it cannot be denied that many things absolutely fail which, in the enthusiasm of inventors, or in the careless or unscientific examinations of those who some times allow visions of immense fortunes to warp their sounder judgment, appear to be the greatest thing the world has ever seen. It often turns out that practice and theory do not agree, but whenever this is the case it is safe to conclude that an error has crept into the theory.

It has been said that "the records of the Patent Office give the births of inventions, but there is no record of the deaths." This is very true, and if one but studies that list of births carefully, he will be struck with the wonderful similarity of the characteristics of many of them. Alas! how many are stillborn, or at least die young. History repeats itself in patents as well as elsewhere, and often with *very* slight variations.

The time of an Association, gathered from the four corners of the Continent, is too valuable to be wasted, and anything that has true merit can easily cause itself to be recognized everywhere, and will not hesitate to submit itself for examination and approval to an Executive Committee especially charged with protecting the true interests of the Society.

In this way much useless talk, which amounts to nothing, is cut off, and matters of real interest can be attended to. The vast majority of the members are engaged in making gas, and what they want for their guidance is the experience of others, mutual interchange of ideas, and facts not theories. There is no class of men engaged in any business that watch more carefully for improvements therein than do the Gas Managers; but many of them have "experimented" expensively, and it is well that they be careful in these hard times, and examine and see if there is any real scientific basis for claims made before unnecessary expense is incurred which can only lead to failure.

The papers read before the meeting were interesting and instructive, and will, we trust, be studied by all—both those present and those who were not. In another column will be found the President's address, and a paper by Mr. Cathels, both of which speak for themselves. In the conduct of this meeting the Association has taken a long step forward, and there is no reason why its

future meetings should not continue to improve. If the gas managers are true to themselves, and to the honor of their profession, they will take the highest pride in preparing for these meetings, and taking part therein in the future; and theirs will be the blame and the shame if the American Gas Light Association does not stand second to none at home or abroad.

CROTON WATER.

The present season has been one of unprecedented drought in the valley of the Croton River. The very free use, and much freer waste of water, indulged in in this city makes the amount consumed very large. The amount of water brought into the city is enough to give to each inhabitant about 100 gallons per day. Of course such an amount can not be legitimately used, and a large percentage is daily wasted. How to stop this waste is the first problem to be solved. The means of waste are numerous, and the people have become so accustomed to it that they do not appreciate its serious consequences. While all along the water fronts there are numbers of hydrants left running which deliver a large amount of water directly into the river without serving any useful purpose; still this is not equal in amount to that which is wasted by the countless number of small streams left running in private houses, which, in the aggregate, exceed perhaps all other sources of waste. The theory upon which the Water Department has heretofore been conducted, is that the people own the water works, and that they are entitled to have the water by merely paying a tax sufficient to pay interest on their cost and the expense of maintainence. This is all very well as long as the supply is inexhaustible. But stern facts appear before us to-day to show that the supply is not absolutely or practically inexhaustible. The area of water shed of which the Croton is the outlet is about 400 square miles.

Supposing that we had to-day enough storage capacity in the valley to hold all the surplus in wet time, to meet the demands of dry times, this water shed would give us about 400 millions of gallons per day throughout the year. For the past few years nearly 100 millions of gallons per day have been brought into the city, thus showing that one-fourth of all the supply available is now being consumed. The amount of water used per capita in large cities increases much faster than the population, where anything like freedom in its use is permitted. These are facts of which any one may satisfy himself if he chooses. The important thing to be done at the present time is to STOP THE WASTE. Most stringent measures must be taken to that end until such time as relief comes by means of long, continued, soaking rains.

It may then become a question how to prevent waste in future. In many cities the application of water meters to the services has been found to reduce the waste very materially. There would seem to be no good reason why each one should not pay an amount for water in something like a proportion to what he uses. Make the rates as low as possible, and give an advantage in rates to those who use the meter, and the benefit would soon appear. As to the future supply of this vast metropolis, that is a matter which cannot be too soon taken into consideration by those responsible for the supply, assisted by the best engineering ability that the city can command. To-day the city depends upon a single line of aqueduct 34 miles long. An accident to any part of it, requiring one week for repairs, would leave the city with a *very* short supply of water. Does not prudence dictate the immediate construction of another line of supply. Cost what it may the expense would be a bagatelle compared with the damage resulting from a temporary suspension of a supply to the whole city.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

The *Journal of Gas-Lighting*, of London, is about to issue in monthly parts, this valuable treatise which has been appearing in its columns for some time past. It will be one of the most valuable compendiums of informatinn on the past and present practice of the Science that has ever appeared. It will be liberally illustrated with plates and cuts, some of which alone will be well worth the price of the numbers containing them. We recommend every coal gas maker to subscribe for it. Subscriptions may be sent to this office, and the copies will be furnished as soon as they are ready. Full particulars as to price, &c., will be given as soon as possible. Each number will contain from 28 to 32 pages; and the pages are about 10 × 12 inches. They will be issued in paper covers, and can be bound to suit individual taste after all are received.

On the Failure of the Worcester Dam.

A REPORT BY THEODORE G. ELLIS, C. E., DAVID M. GREENE, C. E., AND WILLIAM W. WILSON, C. E., MEMBERS OF THIS SOCIETY.

[Presented June 15th, 1876.]

The details of the catastrophe derived, chiefly from the accounts in the *Worcester Spy*, are as follows:

During the day preceding the final failure, attemps to stop the leak had been made in various ways without much effect. Some time before daylight on the morning of the day the dam gave way, Thursday, March 30th, a section of the dam between the upper gate-house and wast-way or "roll-way" as it appears to have been generally called, about 20 feet wide and 5 feet thick, caved in. The water followed with a rush and a roar, and above all was heard the grinding of the stones of which the upper face of the dam was composed, as they rolled into the breach. The water then poured in torrents through the doors and windows of the lower gate-house, and the dam was momentarily expected to break. Work was however continued, bales of hay loaded with stones were thrown into the water at the break, and after an hour the flow preceptibly decreased, and the rumbling of the stones as they ground over each other was no longer heard.

With the dawn of day the exertions of the workmen were renewed. The barns in the neighborhood were opened, and the hay loaded in carts and drawn upon the dam, where hundreds of men were only waiting for an opportunity to assist in averting the catastrophe. Axes were brought, and the large pine trees in the grove below the dam were cut down and hauled as near the break as it was deemed safe for horses to go, when they were taken up by the men and thrown into the gap.

At this time, the portion of the dam below the lower gate-house was badly gullied and the stream through the door was falling into a hole about 20 feet deep. An immense quantity of water was flowing through the break, yet the stream above was discharging almost an equal quantity into the reservoir above, so that little headway wa made in drawing off the water. During the day, canals were being cut through the eastern embankment of the dam, so as to allow the water to find its way down through a meadow to Parsons brook. The ground was frozen and this work proceeded very slowly. The cement "spiling wall" was cut through with difficulty, and it was not until 4 o'clock that a passage was made. At this time the leak through the dam had diminished, and it was hoped that by drawing the water off, the danger would be partially averted.

But this hope was without foundation. At ten minutes of six, the water was seen bubbling up through the earth of the dam back of the waste gate-house. The stream when first noticed, was not larger than a man's finger. In less than a half a minute, it was as large as a man's wrist. At the end of a minute, it was as large as a man's leg. In another minute it was as large as a barrel, and was 3 or 4 feet high. Then stones and earth were thrown up in the stream and gradually the earth began to cave in. Foot after foot of the solid embankment, now thoroughly honeycombed by the action of the water, gave way. Then sections varying in width from 2 to 5 feet, began to drop off, until the embankment was gone back to the face of the dam. The cement spiling wall held for a moment after all the earth had been washed away. Then a hole appeared in the centre of the wall, gradually its size increased, until with one grand crash the spiling wall crumbled, letting loose the 760,000,000 gallons of water stored behind.

The water rushed down the ravine in a solid mass, 20 feet high. First in the line of the flood was the stone waste-gate house. When the flood struck this, it tottered, then the key-stone of the arch dropped out, a corner of the building next gave way, followed by the wooden roof, which was swept onward until drawn into a whirlpool, when it was crushed to matchwood and thrown into the air. The gate-house was tipped over bodily, and not even a stone of it has since been seen. When the dam first broke, the gap was about 20 feet in width. This increased rapidly after the water had once gained a passage, and continued to increase, until the width was about 80 feet. The ravine below being narrow, held the water back, and it continued to run for about three hours before the reservoir was exhausted. Another account says:

At twenty minutes of six, the earth at the surface in the rear of the lower gate-house suddenly became very muddy, and the water bubbled through in another instant. The scene for the next five minutes was terrible yet grand. The water continued to ooze through the earth, and in about two minutes, a small stream was running. Two minutes later, the stream had increased, and at the end of seven minutes the water, which had worn a deep gulley, began to work backwords toward the break in the face of the dam.

The trees, stones, bales of hay, and timbers, thrown into the breech, were thrown through in a violent manner, and every moment the break was enlarging, until only the spiling wall remained. This gave way in another moment, and the space at the top was about 15 feet wide, through which the torrent was pouring and continually enlarging, until the rush of water was over, and the waters of the reservoir had been sent down upon the valley below.

During the first hour, the water was drawn down about 10 feet. The upper gate-house stood untill nearly the close of the first hour, when the masonry gave way bodily. The foundations fell across the stream. The upper portion was wrecked in an instant, and the granite blocks of which it was built, added to the boulders passing down the stream, increased the rumble and roar, which was heard above the noise of the rushing torrent. For three hours the flow continued, until the gap was 150 feet wide at the top and about 50 at the base. By eight o'clock the reservoir was nearly emptied. (*Signed by the Committee.*)

MR. WILLIAM J. MCALPINE.—Soon after the

disaster, which is the subject of this paper, Messrs. Cunningham, Francis, Shedd, Worthen and myself, members of the society, were appointed by the corporate authorities of the city of Worcester, a commission, to examine and report upon the causes of the failure. This commission spent days in searching for evidence, from those who built and those who maintained the dam, those who witnessed the devastation its failure caused and others whose professional and personal knowledge of the fact qualified them to speak as experts.

I cannot assent to the conclusions of the report just read. At an early day, I hope to be able to present to the Society my views of what led to this disaster, founded upon the evidence thus obtained and such observation and experience as has been possible for me to bring to bear upon the case.

Municipal Works of Brussels.

[Translated from "Le Gaz," for Am. Gas-Light Journal.]

[Concluded from page 177.]

The two exhausters are double-acting pumps, with coupled cylinders, each provided with a governor, which acts on the steam and gas valves.

There is one auxiliary Korting's steam jet exhauster, which may be used for gas as well as for revivifying the purifying material in the boxes.

The exhausters are connected in such manner that they can be used singly or combined, and may be used to draw gas from the retorts and press it into either the holders or mains direct, or into holders and mains at the same time.

Boilers.

There are three boilers, with Galloway tubes and inside fire-boxes, of 20 horse-power for driving the engines of exhausters and purifiers.

Purifiers.

The purifying material is oxide of iron and lime, the latter is always used in the last boxes. During the last winter there were numerous experiments made to find some other material more effective than the Laming's mixture, and, if possible, cheaper. Very satisfactory results were obtained by the use of the remnants of the roasting furnaces for iron pyrites from chemical factories. This material is now almost exclusively used, its purifying power being superior to Laming's mixture, and its cost almost nothing.

The purifiers are made of two boxes each, one fixed like the common box, and an inside moveable one which contains the purifying material. This latter can be transported by the steam travelling crane to any part of the house. After the the cover is lifted from the stationary box, the inside one is taken out, and taken to the revivifying house, and the traveller returns with a previously prepared box full of fresh purifying material. This being placed in the stationary purifier box and the lid put on. The whole operation is quickly performed without hand-labor.

The revivifying of the material is either performed in the boxes, or on a perforated floor, with an air current from the Korting exhauster, or from a blower in a short time.

This rapid manner of working the purifying material has admitted of a considerable reduction in the number of apparatus, and thereby reducing first cost of plant, with a considerable saving of hand-labor.

There are few more extensive works than those of Laeken, which are of really imposing magnitude.

The 24 purifiers are arranged in two series, divided in sets of three each, each purifier is provided with a "Kruger" bye-pass, with connections so arranged as to admit of each set or single purifier being isolated.

One of Brotherhoods three cylinder engines drives the traveling crane.

Station Meters.

The three station meters of 50,000 cubic meters each are the largest built to-day.

Holders.

There are three holders, two of 11,000 cubic meters each, and one of 22,000 cubic meters. The tanks for the two first are of sheet iron strengthened with rings; for the latter the lower portion is strengthened by channel iron, the upper portion is of plain rivetted plates.

The holders are non-trussed, and rest, when down, on wooden trestles. They are different from those built now in their circular framing, and in their inlet and outlet pipes being accessible outside of the tank, which places those in charge of repairing and cleaning the pipes beyond danger of suffocation. Heating pipes keep up the temperature in the tank in winter.

Shops, etc.

The last group of buildings comprehends the forges, machine-shops, carpenter-shops, basket-maker, stores and offices.

There are two mains of 85 cm. and 60 cm., respectively. All pipes have flange and spigot ends, and the joint made with rubber rings.

One of Giroud's governors, with return main, secures even pressure.

Being near the railroad station of Schaerbeck, and the canal of Willbrock, with which it is connected by rail, the works occupy an exceptionally advantageous position. The coals of "Borinage," England and Germany may be brought either by water or rail to the very doors.

The coke, delivered at wholesale, goes to Flanders and France, and there is also one depot in the city for retailing.

The tar brings 61 francs per ton, the ammonia-water, 1fr. 25 cent. per ton coal carbonized, and there has been a separate building for the treatment thereof erected at the works by the contractor.

Gas-Light Intelligence.

United States.

Gas Explosion at the Highland Military School.—Considerable excitement was occasioned upon the streets last evening by a rumored serious accident at the Highland Military Academy. Investigation showed the rumor not without foundation, and a *Press* reporter was immediately sent to the institution to gather facts, which are substantially as follows: It appears that the various appartments of the Academy are artificially illuminated by gas manufactured upon the premises, the gas holder being underground and away from the several buildings. The approach to the gas holder is through a wooden structure located directly over the holder and entered by a kind of trap door. Mr. Metcalf, principal of the academy, has lately contemplated introducing steam pipes to the exterior of this gasholder, for the purpose of improving the illumination during the cold season. Last evening, at about 8 o'clock, in company with his carpenter and a farm hand. Mr. Metcalf went to this gasometer to make some preliminary examination, carrying a lighted lantern. He had scarcely raised the trap door when the inflammable vapor arising from the gasholder took fire from the lantern, and an explosion followed, which at first led to the supposition that the entire contents of the gasometer had gone off. The three men were of course enveloped in the flame, and all were quite painfully burned, Mr. Metcalf being injured most severely of the three. They were all conducted to the rooms of the principal, and physicians immediately summoned. Doctors Woodward and George Bates arrived shortly, and after brief examination decided that the injury in the case of each was confined to the surface, and not of a dangerous character. Applications were at once made to relieve the pain by excluding all injured parts from contact with the air; and when our reporter left soon after 9 o'clock, the three men were comparatively comfortable, though presenting a strange and unnatural appearance in the coating of cotton and flour with which they were disguised. Doubtless it will now be considered that hardly proper care was observed in approaching the gas works with a lighted lantern; but the holder was known to be perfectly tight, and no one supposed that any inflammable vapor existed beneath the trap door and outside the holder. The result, however, shows that there was considerable vapor of a highly combustible nature; for the earth about the wooden structure is displaced as only a real explosion would be likely to displace it. It seems at this writing that Mr. Metcalf and the Messrs. Morse who were with him and shared in the accident, will be confined for a while with painful burns; but they have all probably escaped more serious injury.—*Worcester (Mass.) Press.*

Great Britain.

Mr. Camus, Engineer of Ponts and Chaussées, the manager of the Paris Gas-Light Company, has just been decorated as an officer of the Legion of Honor by the French Government. This distinction is conferred as a recognition of the ability and scientific attainments, which have been displayed by Mr. Camus in the administration of the affairs of the Paris Company, and shows that although a government officer employed in the service of a civil corporation, still the government is not unmindful of the efforts of its officers in promoting the material interests of those undertakings, which do so much for the safety and comfort of the people.

Mr. Emile Durand.—At the last meeting of the American Gas-Light Association, Mr. Emile Durand, the Editor of "*Le Gaz*" the French Gas-Light Journal, was made an Honorary member of the society.

This is a just tribute to the high ability, untiring industry and zeal of the man who has contributed more perhaps, than any other, to the literature of the gas interest, for which in his own country, he has received the highest honors from the Society for the Encouragement of the Industrial Arts.

American Metric Bureau.

There has been recently incorporated in Boston an association of teachers and others interested in the introduction of the Metric weights and measures, under the name of the American Metric Bureau. Art 2 of its constitution reads as follows:—

"The object of this Bureau shall be to disseminate information concerning the Metric System; to urge its early adoption: and to bring about actual introductions wherever practicable. To this end it will secure the delivery of addresses; publish articles; circulate books, pamphlets and charts; distribute scales and measures; introduce the practical teaching of the system in schools; and in all proper ways, as far as the means at its disposal will allow, the Bureau will urge the matter upon the attention of the American people till they shall join the rest of the world in the exclusive use of the International Decimal Weights and Measures."

This Bureau already includes among its members many of our prominent educators, and its numbers are rapidly increasing. An office has been opened at 13 Tremont Place, Boston, and as soon as suitable arrangements can be made, branch officers are to be opened in New York, Philadelphia, Chicago, and other central localities, where all persons interested are invited to call or to write freely in regard to any matter pertaining to the work of the Bureau.

Fourth Annual Meeting of the American Gas-Light Association.

NEW YORK, OCTOBER 18, 1876

The Association met in Chickering Hall at 10 A M., and was called to order by the President, General Charles Roome.

Considerable time was occupied in the admission of new members and the payment of dues.

On motion of Mr. Neal the reading of the minutes of the last meeting was dispensed with, they having been already printed.

The reading of applications and notices and reports for new members was then proceeded with. The secretary read the names of the gentlemen who had made application to become members of the Association, together with the members of the Association who had endorsed their application.

The election of new members was then proceeded with. Messrs. O. Zoilicoffer and A. C. Wood were appointed tellers.

On motion of Mr. Price the secretary was authorized to cast a ballot on behalf of the Association, for the gentlemen whose names had been read.

The Secretary then proceeded to cast a ballot, and the following named gentlemen were declared by the President to be duly elected as active members of the Association:

M. N. Diall, Terre Haute, Indiana.
Patrick J. Salmon, Franklin, Ind.
Thomas C. Hopper, Clarksville, Tenn.
Charles E. James, Chattanooga, Tenn.
W. H. Linton, Ravenna, Ohio.
B. E. Lehman, Bethlehem, Penn.
Philip Peebles, Quebec, Canada.
J. H. Rogers, Jamaica Plain, Mass.
W. H. Perry, Bangor, Maine.
M. Harington, Niagara Falls, N. Y.
George H. Wells, Nashville, Tenn.
William Farmer, New York City.
William J. Valentine, Poughkeepsie, N. Y.
James Williams, Johnstown, Penn.
Chas. C. Van Benschotin, New Rochelle, N. Y.
Edward Lindsley, Cleveland, Ohio.
John Andrew, Chelsea, Mass.
T. F. White, Houston, Texas.
J. C. Tiffany, South Boston, Mass.
I. Herzog, New York City.

ADDRESS OF THE PRESIDENT.

The President then delivered his annual address, as follows:

Gentlemen of the American Gas-Light Association:

Again it is our privilege to meet in annual communication to compare notes on the occurrences of the past year, and to deliberate on matters pertaining to the important industry with which we are connected.

In common with our fellow citizens engaged in other pursuits, we have felt the depressing influences which have affected the course of trade and manufactures throughout the country, and indeed the world, and yet to-day, I trust with them, we feel also the encouragement arising from the evidences of renewed activity and confidence which is beginning to make itself felt.

Whatever of improvements in apparatus, or in the processes of manufacture have taken place, are doubtless familiar to most of you, for they are regularly spread before you in the columns of the AMERICAN GAS-LIGHT JOURNAL, which is so ably conducted by the distinguished engineer who has the editorial charge of that most valuable periodical. To sustain it and to contribute to its usefulness among ourselves, should be the effort of us all.

I am one of those who do not believe in sudden, startling developments in our profession. With us everything must of necessity be reduced to a mathematical demonstration. The laws of chemistry and of engineering are exact and clearly defined. *Patient* investigation—*careful* investigation—numberless experiments, close observation and calm, deliberate thought are required of us. Nothing should be taken for granted until clearly and unmistakably proven. Step by step we advance as experience and severe study guide our investigations. To jump at conclusions in a business like ours is sure to produce loss and disappointment.

In the course of a long experience, extending over something more than forty years, I have witnessed many *so-called* wonderful discoveries, which at the time appeared to those not regularly brought up in the business, as certain to revolutionize the entire process of gas-making, and I have seen these wild schemes topple down one after another, carrying in their train bankruptcy and ruin to the credulous dupes of the ignorant or the designing. So plausible are the specious arguments of these adventurers, who generally commence by deceiving themselves, and finding among men of means willing listeners anxious to acquire suddenly still greater wealth, it can scarcely be wondered at that so many abortive efforts have been made to obtain results which common sense and an intelligent knowledge of the business of gas-making would have served to show, were simply utterly impracticable.

The wild ideas which so generally prevail of the enormous profits of the companies already established, and the claims set up by these pretenders to scientific knowledge do, and probably will continue to find encouragement among those who are willing to take for granted what is so boldly asserted, without troubling themselves to ascertain by careful enquiry, whether or not there is or can be any reasonable grounds of success.

Let those who are regularly engaged in the legitimate business of gas-making avail themselves of every opportunity of acquiring knowledge, and adopt such improvements as the judgment and experience of their associates approve. Thus we will continue to progress, and thus we will avoid those disasters which a different course of procedure will certainly entail upon us. It is for this purpose we have established this Association, that each may avail himself of the experience of others; that no one need to grope his way single-handed and alone, but that each member may ever have the beacon of experience not of one, but of many, to guide him in the conduct of his responsible and arduous duties.

Let us calmly consider whatever is presented here, calculated to promote the general welfare. Let us examine without prejudice the plans and recommendations submitted for our deliberation, and by our mutual counsel endeavor to obtain the most reasonable solution of the problems we may be called upon to discuss. While such is our object and aim, this institution must prosper, greatly to the advantage of the profession of which we are justly proud, and prove beneficial to all who are in any way affected by our actions.

REMINIICENCES.

It may not be inappropriate that I should refer to something of my own experience in the business to which we are devoted. Would that I might make an adequate record of the noble men who stood as the advance guard in our profession at the time I joined it. As forty years have rolled along, those honored names have one by one passed into history, and though they have gone from us, still they live in their influence, their example, their honesty, and their high scientific attainment. In England there were Clegg, Thompson, Lowe, King and Barlow, while in our own land we had Torrey, Ellet, Cresson, Campbell, Darricott and Merrick.

Upon us has fallen the honor and the responsibility of taking up the work where they left it, and carrying forward to their full fruition the many improvements whose inception may be traced to their study and their labors. Let us not look lightly upon the responsibility of our position, but make it our constant study to see to it, that nothing occurs to dim the lustre which their names have left upon our honorable profession.

EARLY USE OF GAS.

When my connection with the business began there were, I believe, but four or five gas companies in this country; one in Baltimore, one in Philadelphia, one in Boston, and two in this city, and I think, one in New Orleans. Private attempts were made to light individual buildings but with indifferent success. One of these was in the New York State Prison. I have heard my mother say that if I did not succeed in making better and purer gas than the chemists made in those days, it would be well for me to choose some other calling; but we have learned better since, and sulphuretted hydrogen is now so easily removed, that there no longer exists any trouble on that account.

When I first became engineer of the Manhattan Gas-Light Company there were not a dozen private dwellings lighted with gas in this city; there were very few gas street lamps above Grand street, and they were mostly confined to Broadway and the Bowery. The prejudice against the use of gas light was very great. It was believed to be dangerous, injurious to furniture, and altogether too trying for the complexion of the fair sex.

I was once severely censured by my directors for laying gas mains in Union Square, and in the streets around Gramarcy Park, and one of them sold his stock because he saw nothing but ruin for a company which tolerated the extravagant ideas of an engineer who laid pipes as far north as Twenty-ninth street.

DRY METERS.

In those days there were no dry meters. Mr. Bogardus, of this city, who was the inventor of the dry meter obtained a patent here, but failed to get one in England. I believe he made nothing by his invention. His meter was defective only in this—that the diaphragm which was, I think, of *oiled silk*, was not sufficiently steady in its action.

Derfrees improved on this by using leather, and fastening to the leather tin plates, in a manner now familiar to you all. When the World's Fair was held in this city in 1853, Mr. Bogardus saw there a dry meter made by the late Mr. Samuel Down, which was on exhibition. He called to see me on the following day and was surprised to learn that it was extensively used in England, and was likely to be generally adopted in this country. He tried to get a renewal of his patent for which Mr. Down offered to pay him a large sum, but it was too late, and Mr. Bogardus shared the fate of many other inventors, witnessing the accumulating wealth of those who knew how to adapt what *they were incapable of inventing.*

CLAY RETORTS.

There were no clay retorts used in American gas works until I introduced them from Belgium. Even our iron retorts were imported from England, and in fact, all our apparatus came from there.

TANKS, ETC.

The Boston Company used wooden tanks for their holders, and the companies in this city had cast iron tanks placed above ground which, together with the holders, were imported. I cannot tell when the other cities began to manufacture the apparatus required by gas companies, but I know that my company never purchased any here until I took charge of the works in 1841. Our business was small at that time. We were making less than 50,000 cubic feet of gas per day, and there was little confidence felt by our stockholders in their investment.

How vast the change since then. From a mere article of luxury, or at best convenience, gas light has become a matter of prime necessity. There is not a dwelling in the country, where it can be had, which does not use it in preference to any other means of illumination. Then it was confined to stores and workshops. By degrees it found its way into places of public amusement, into churches, and other large buildings, but it had a hard struggle before it secured a permanent location in the library and the drawing-room. As men of education engaged as engineers and chemists in the study, and devoted their talents and their energies to the discovery of new methods of manufacture and purification, step by

step this new light forced itself upon the favorable consideration of the public, and the manufacture and distribution of illuminating gas became a matter of pure science and so it stands to-day. We whose privilege it is to follow in the steps of the distinguished men whose names I have mentioned, and who were in constant communication with others equally distinguished, but with whom I had not the honor of being personally acquainted, must realize how great is the responsibility which rests upon us. We may not, we must not stand still. It would be a disgrace to us and to our country if we did so. We must prove that we appreciate highly, as we ought to appreciate, the dignity of our profession, and we must by individual and united effort move forward in the path we have chosen, and show ourselves worthy of the mission which has been entrusted to us.

Avoiding then all countenance with the charletans who will from time to time arise, endeavoring to force their pretended discoveries upon those whose fears as stockholders are easity excited—let us pursue the even tenor of our way, working steadily and intelligibly in accordance with those laws which nature and pure science have fixed as unalterable. Here a little, there a little, permanent progress will be made. If we are wise we will be content with this, and not let every idle notion which presents itself, disturb our equanimity or our faith in principles which are firmly established.

STUDY IMPERATIVE.

Far be it from me to discourage any improvement. The most valuable ideas are sometimes obtained from the humblest workman, whose means of observation may be greater than those of the engineer in charge. Encourage by all means this habit of observation, and give full credit to those who deserve it, but reserve your own judgment, and do not seek to have adopted the ill digested notions of those who are incompetent to judge between truth and error. I would say to the young engineer, if you are desirous of becoming eminent in your profession, you must study and study hard—you cannot become master of your business in one year or in ten years. You must read something more than "Clegg's Treatise," or "Ure's Dictionary." You must not only *read* but you must carefully *study* the scientific journals of the day. You must converse with those who are older than yourself and who will cheerfully give you the benefit of their experience. Of all the professions in the world, I know of none more honorable than that of the engineer, and of no class of men more liberal in their views or more willing to aid and encourage the young. Then live up to your profession and be an honor to it, for every advance you make is for the benefit of mankind.

RESIDUALS.

Until within a few years very little effort was made to utilize in this country the secondary products of the retort house. The coal tar and the ammoniacal liquor were permitted to run to waste. Now, however, the case is different, and we have reason to hope that these valuable articles will become before long, sources of profit to the producers and the manufacturers.

CHANGES IN APPARATUS.

Much might be written on the changes that have taken place in the apparatus used by the gas companies here during the past forty years. The old fashioned box washer giving way to the jet, the jet to the scrubber, and the scrubber itself modified from time to time, as experience suggested. The purification by lime and by oxide of iron, and the controversies growing out of the use of one or the other—the substitution of clay retorts for iron, and the earnest arguments advanced by the advocates of each—all these have passed into history, but it is none the less interesting to look back and reflect upon the steady progress made as experiments after experiments were published, and discussion after discussion through the columns of the scientific journals were had, between the very able engineers and chemists of England and Scotland. There is no reason to doubt that we will continue to advance from year to year. Differences of opinion will exist, and we will all get the benefit to be derived from fair, candid, courteous discussion. Both here and in the Journals, and in the reports of kindred associations we are to look for information in all matters connected with our calling, the nature of which, though at times full of anxiety and always of great responsibility, is still so fascinating to the intelligent student of science, as to reward with success the faithful and conscientious seeker after truth.

I have thus glanced as briefly as I could at some of the important changes that have taken place in my day and within my own observation. All the distinguished engineers whose names I have mentioned, and with some of whom I was on intimate terms, and to whom I was warmly attached, have gone before me to the regions of perpetual day.

In a few brief years I must take my place also as one of the departed, and I ask no greater honor in this world than to have my own name recorded as worthy to be inscribed on the same page with theirs.

Gentlemen, thanking you for your patient attention, I respectfully submit the business of this Association to your careful deliberation.

The report of the Executive Committee was then taken up. The secretary of the committee read the report which was as follows:

At a meeting of the Executive Committee of the American Gas-Light Association, held at the Hoffman House in the city of New York, on Tuesday, October 17, 1876, at the hour of 8 P. M. After due deliberation the following were recommended to the Association for action and adoption.

Resolved, That we recommend the election of Mr. Emile Durand, of Paris, France, as an honorary member of this Association.

Resolved, That the application of R. P. Rothwell for the selection of the *Engineering and Mining Journal* as the official organ of the Association be declined.

Resolved, That the AMERICAN GAS-LIGHT JOURNAL be, and is hereby designated as the official organ of this Association, and that it be recommended to the gas interest generally for its aid, encouragement and support.

Resolved, That the salary of the Secretary and Treasurer be fixed at $350 for the current year.

Resolved, That the sum of $5 be, and is hereby remitted to Mr. F. C. Sherman, on the initiation fee paid by him after his removal from Worcester to New Haven.

Resolved, That we recommend an amendment to the 4th Article of the Constitution, by inserting the word "Secretary" after the word "Director" in the second line.

Resolved, That we recommend that the 17th Article of the Constitution be amended by inserting the word "alternate" before the word "year," in the third line of said Article.

Resolved, That we recommend the Association to decline all tender of hospitalities extended to them as an Association, during the present or any future session.

Resolved, That the Association be recommended to adopt the following rule relative to discussions. That no member shall be permitted to speak more than twice on the same question, without the consent of the Association.

Resolved, That all propositions which may be offered for the discussion of any patented right or process shall be submitted in writing, and referred to the Executive Committee for its approval.

The Secretary then read two letters from Monsieur Emile Durand of Paris, one of which is as follows:

"PARIS, September 21, 1876.

"Mr. CHARLES NETTLETON,

"Sec. American Gas-Light Association, N. Y.

"Sir: Having learned by the AMERICAN GAS-LIGHT JOURNAL of the 2nd of this month, that the society of which you are secretary will hold its annual meeting on Wednesday the 18th October next, I take this opportunity to place myself in communication with my confrères, the Managers of gas works in America, and to establish with their society relations which cannot but be useful in the development of our common industry. Consequently I have sent to your address, to be offered to them, a set of my special works, viz.:

"1st. Review of the Jurisprudence of the Council of State. (Supreme Court.)

"2nd. Special Legislation, control of the quality of gas, meters, etc., etc.

"3rd. Service of Public Lighting. Advantages of the use of gas, etc.

"4th. The first three volumes of the Gas Annual.

"5th. Oxyhydrogen Light—official reports.

"I send you also a copy of *Le Gaz*, and shall be happy to send it to you regularly in the future.

"I beg of you, sir, to offer these works in my name to your Society of Gas Managers of America, transmitting to it at the same time the letter herewith enclosed.

"I had wished to add to this list of works, in order to acquaint your committee more fully with myself, a report made upon my works by the Institute of Industrial Arts, but this report is still in press, and I can only send it to you by the next mail. Relying upon your amiable courtesy, I pray you to accept with my thanks the assurance of my most distinguished consideration. (Signed) EMILE DURAND,

Eng'r, Editor of the Journal *Le Gaz*, Honorary Member of the Brit. Asso'n of Gas Managers, Member of Society for the Encouragement of Industrial Arts, Etc."

On motion of Mr. Clement White the secretary was directed to cast a ballot on behalf of the Association, for the election to honorary membership of Monsieur Durand.

The Secretary then proceeded to cast the ballot for the gentleman named, and he was declared to be duly elected an honorary member of the Association.

The President—I think there ought to be a resolution accepting the gift which he has proffered, and a vote of thanks tendered by the Association, but this we can attend to after we get through with the rest.

On motion of Mr. Harbison the report of the Executive Committee was then taken up and considered *ad seriatem*.

The second and third recommendations of the committee were then adopted.

The fourth recommendation being under consideration Mr. Harbison said: I think we ought to see the treasurer's report before we act upon this recommendation of the committee, so as to know the financial standing of the Association, and be able to act intelligently in regard to the matter. I therefore move, sir, that that recommendation be laid upon the table for the present. Carried.

The fifth recommendation was then adopted.

The sixth recommendation being under consideration the President said: The object of this is simply to enable a gentleman who is secretary of a gas company to represent the company if he pleases.

Mr. Neal—At the last annual meeting of the Association I suggested that the word "clerk" be inserted. In the State of Massachusetts those who hold the position similar to that of secretary in New York and other States, are designated as clerks. All the secretaries of manufacturing corporations are designated as clerks. It may be that such cases will come up before the Association. The Executive Committee considered the matter, and it was thought best to use the word "secretary," as that term is synonymous with the term "clerk," as it is used in the State of Massachusetts, so that if a clerk of a company should apply for membership, he would be admitted under the name of "secretary."

The President—It is the same office as secretary, and a person applying as clerk would, of course, come under that head.

The recommendation was then adopted.

The seventh recommendation of the committee was also adopted.

The eighth recommendation being under consideration Mr. Cornell said: Mr. President—Before we act on this portion of the report of the committee, I should like to hear some reason why it should be adopted.

The President—The reason is that there are a good many gentlemen here who would be very glad to give elegant entertainments, as has been the custom since our meetings have been held here; and while it is a considerable tax on them, it might be a severe tax elsewhere, should the Association change its place of meeting at any subsequent time, and parties in such places connected with our business, might not feel that they could afford to do it, and yet would not want to appear small.

Mr. Neal—I objected slightly to the phraseology of that resolution last evening, and I would suggest, Mr. President, that it be changed. It speaks about hos-

pitalities being extended to us "as such." I would suggest that the word "Association" be put in.

The motion of Mr. Neal was adopted, and the word "Association" inserted. The recommendation as amended was then adopted.

The ninth recommendation was also adopted.

The tenth recommendation being under consideration the President said: The object of this is simply to prevent wasting our time in the discussion of patents which may or may not have merit in them. Of course we are all willing to listen to those who have anything to suggest which may be of importance to the Association, but we know there are many patents which claim to be improvements, and we are liable to waste our time this year as we did last, in the discussion of them. We do not wish to prevent any person from advocating or explainieg his patent if he have any, but if the matter is referred to the committee he can explain it to them, and it can be passed upon by the committee and thus save the time of the Association.

The recommendation was adopted.

Mr. Clement C. White—I move, Mr. President, that the volumes tendered to the Association by Monsieur Emile Durand be accepted, and that a vote of thanks on behalf of this Association be returned to him for the same. Carried.

Mr. Price—I move that a committee of three be appointed to take into consideration the question of the proper place for us to meet next year, and report at some time during the session of the Association, so that it can take action upon the matter. If necessary, however, I will modify the motion so far as to refer the matter to the Executive Committee, and that they be requested to take up the subject and report. The motion of Mr. Price as modified was carried.

The President—The Treasurer's report is next in order.

Mr. Harbison—I ask that the report of the treasurer be temporarily laid on the table, for the reason that the chairman of the Finance Committee has been sick and is not able to be present, and I am obliged to make the examination alone. It is not yet complete. I hope, during the recess, to complete it so as to be able to present it at the afternoon session. You will find, by reference to the Constitution, that the Finance Committee is required to examine it previous to the meeting, and they ought to be able to report on it at the time it is presented. A half hour will be sufficient to complete the examination, and that time I can spend upon it during recess.

The motion of Mr. Harbison was carried.

Mr. Neal—On the list of members as printed in the book, I find there are several gas companies which appear as members there. Now, by reference to the fourth section of the Constitution, you will find that a person to be a member of the Association must be a president, or officer, etc. I hope that the secretary will take measures to substitute for the names of the gas companies the names of individuals. I do not think it is intended to be a society or an association of gas-light companies, but of individual members. I see here the names of several gas companies instead of the names of individuals.. Cannot that be changed?

The Secretary—Most of the older members will recollect that when the Association was first formed of gas companies who sent delegates, it was found not to work successfully. Then a new form of organization was proposed and the present Constitution adopted, requiring individual membership On the record the names of companies appeared. I continued to make application for individual names in place of the companies, from that time down to last year. At the annual meeting the Executive Committee took up that subject, and instructed the secretary to ask the companies for the names of individuals to represent them, and to be members of the Association. Some individual or some officer who would be eligible to election under the fourth section. Most of the companies have replied, and individual names have been put in; a few, however, have not. Some have replied since the book was printed, but as I desired to circulate it among the gas companies I had to take it as it existed at that time, and could not wait for any other changes. They will be made from time to time, until the entire change has been effected.

Mr. Harbison—I rise to a point of order upon the remarks of the secretary in regard to this matter. It seems to me that the method he has adopted is not doing the business properly. I do not see what right the secretary has, even by direction of the Executive Committee, to put individual members on the list in place of gas companies that have been received as members. It appears to me that this can only be done by a vote of the Association. I mean the striking out of the name of a company from the list of membership, and regularly electing individuals in lieu of them. I think that any such change will not be strictly according to the Constitution. These individual names that have been sent in during the past year ought to be voted for as members of the Association, and the names of the company stricken from the list; otherwise individuals might become members of the Association without its knowing anything about it, and they might be such that we would not care to have them as members. I do not say that this has been done, but it is establishing a bad precedent, and it is likely that it might occur. I move that the secretary be requested, during the session, to prepare a list of the names of those that ought to be changed in this way, so that we can, as an Assoctation, set the matter right according to our Constitution. If we are to erase the names of companies from the list, and substitute the names of individuals to represent the companies that are already members, it ought to be by action of the Association.

The President—Then do you propose to have those individuals as such to take the place of the companies?

Mr. Harbison—That would be the motion. sir, as soon as the list is prepared.

The President—Having once admitted a company, can any change of your Constitution deprive it of the rights that you have once given it? That is a serious question that at once arises.

Mr. Pishon—It is possible that the companies which have been elected members of the Association may have the right to designate who shall represent them.

The President—So I understand it. The companies that have been applied to by the secretary for an individual name may, I suppose, designate a person to represent them who can become a member. There are a number of companies mentioned here who joined this Association as companies. Some have been represented by the president and some by the superintendent, and engineer. They have undoubtedly got rights as members of the Association, and the question is whether anything you could do can interfere with them. I don't suppose, however, there will be any objection to the course proposed. All we want to do is what is right according to the Constitution.

The Secretary—I don't think it will be possible to furnish that list during this session. I beg to read the resolution of the report of the Executive Committee last year, and which was adopted by the Association. [Reads report of Executive Committee of last year.]

Mr Harbison—It does not seem to me that that report authorizes the secretary to erase the names of companies that are already members from the list, and insert in their places the names of individuals. I think that the meaning of that resolution is, that in future he shall recognize only individuals instead of companies. It does not mean that he is authorized to erase the names of companies from the list. and substitute individuals in lieu of them, but that any future application shall be in the names of individuals, and not companies.

The President—The construction that I should put upon that would be, that the Executive Committee recommended, not that those who should come in hereafter, but that those already in should be recognized by the individuals representing them, and not as chartered companies.

The Secretary—Mr. Cartwright was a member of the committee last year and he is here present. I think that was the understsnding of the committee at the time.

Mr. Cartwright—That was the spirit of it.

The President—That was undoubtedly intended by the committee.

Mr. Neal—To facilitate business, so that we may get at more interesting matters, I move that the subject be referred to the Executive Committee, and I hope that those gentlemen who represent companies here will go before the Executive Committee and, if possible, have the change effected.

Mr. Harbison—I withdraw my motion in favor of Mr. Neal.

The motion of Mr. Neal was then carried.

The reports of special committees were then announced by the president to be next in order, but no committee was ready to report.

Mr. Harbison—I move that a committee be appointed to select names of gentlemen to be presented as officers of the Association for the ensuing year. The motion was adopted.

READING OF PAPERS.

Mr. Cathels read a paper on

SOME PRACTICES IN GAS ENGINEERING AND MANUFACTURE CONSIDERED.

Having been requested by the respected secretary of this Association to prepare a paper for this meeting, I undertook to endeavor to comply; but as the time approached, and I began turning over in my mind several subjects in connection with our profession, without finding that I had anything worth saying, if I restricted myself to any one of them, I was in despair forced into the alternative of taking up several instead, and of offering such remarks on each as suggested themselves. To keep the paper within reasonable length the important question of distribution has been excluded other than what arises out of the consideration of the first of the following sections. Such a medley may not be so acceptable as a paper more thoroughly treating some simple topic, but it has the advantage of presenting a wider range for differences of opinion and discussion, and in *that* sense may be the medium of interest and instruction.

SITES FOR GAS WORKS.

The first subject in order that presents itself is that of the selection of sites for gas works to be constructed. It seems to be a generally accepted principle that the lowest level in a district supplied with gas is the most advantageous for distribution, there being an equal delivery obtained with less initial pressure than from a higher level, and consequently, as it is believed, less leakage over the district; and I observe that Mr. Trutwein, in a recent paper on this question—one of a series of able contributions to the AMERICAN GAS LIGHT JOURNAL on "The Manufacture of Coal Illuminating Gas," adopts the popular view. Now I think this presumed advantage is very much overrated. I do not believe the lowest site is necessarily the best in this respect, *my objection indeed being based on the very grounds commonly urged in its favor.*

Owing to the less cost by water than land, carriage of coals and other materials required, and in the removal, especially of the liquid residual products, it is perhaps, generally speaking, desirable that gas works should be situated on the banks of navigable rivers or canals. and as the former are always, and the latter usually, in the lowest levels, such situations may be the most suitable in that respect (but for reasons to be hereafter adduced), this more particularly applies to climates where navigation is open all the year round. Old gas companies, in such temperate climates, have their works frequently so situated as to ensure water carriage, but it should be borne in mind that when they were established, there was, as a rule, no choice between such and cartage, railway communication being either non-existent, or available to but a limited extent.

Another likely reason for the preference, in the early days of gas-lighting, of low level sites, consisted in the fact that the highly important advantages o

exhausters were then lacking, and to reduce the pressure in the retorts the gasholders were lightened by counterbalancing, only weight enough being left in them to give the maximum distributing pressure, and of course the lower the level of the gasholders in respect of the district to be supplied, the less initial pressure was required, and the further could the advantage of lightening the holders be pushed. But these conditions no longer exist, and we ought not to shut our eyes to this fact, and go on reasoning and acting as if they did.

Assuming an average, taking one place with another, and summer with winter, of say six hours heavy consumption out of the twenty-four hours, during which time high pressures are necessary in the mains, there are eighteen hours, or thrice that length of time, when only a minimum pressure is required or desirable, and it is almost needless to say that the leakage of the few hours of high pressures, when there is a correspondingly heavy draught on the mains, is comparatively unimportant to that of the rest of the twenty-four hours, when there is but little consumption, and during which time it is impossible in districts, where the altitudes vary to any considerable extent, to keep the pressures in the higher areas down to a proper limit, without resorting to special means, such as distinct systems of mains supplied at different pressures, gasholders situated in the higher levels, or the employment of district governors; and the lower the level of the works the more is this evil aggravated.

It would thus appear that there are two sides to this much be-praised and believed-in low level site theory, as regards distribution, and in that respect instead of being an advantage it is in many cases a positive and serious disadvantage and source of waste. Without going the length of affirming that gas works may be *above* the level of the bulk of the consumption, of what consequence is it—always assuming the outlet mains to be of sufficient calibre—for the sake of a little extra initial pressure during five or six hours of the twenty-four, whether the works be situated, ten or twenty, or even fifty feet higher? Even at fifty feet only about five-tenths additional initial pressure would be required, say from fifteen to twenty-tenths, the objection to which seems like riding a hobby unnecessarily hard.

But there is another aspect of this question of the site of works, deserving of notice, and which particularly applies to the northern portions of this Continent, in which there are gas works, and to works so situated as to have only water transit available, viz:—the more or less serious depreciation in the quality of the coals, which are, in such cases, necessarily stored in bulk for the six or seven months' consumption, when navigation is closed, through the insensible but certain evaporation of gas from the heap, a loss that materially affects both the quantity and quality of the production, when the coal comes to be used, and which, with the other expenses incurred in stocking, becomes a very important factor in the cost of manufacture.

Mr. Graham, then of the Staleybridge Gas Works, in a series of exceedingly elaborate and exhaustive papers, "On the Valuation of Gas Coals and Cannels," contributed to the English *Journal of Gas Lighting* in 1874, since published by the author in book form, treating on this subject of loss by stocking, estimate the loss on coals costing 20s. 0d. per ton laid down, when the decrease in the production and illuminating power are each but 5 per cent. at 2s. 8d. per ton. As he conclusively shows that the aggregate of the several losses incurred when coal has to be stocked is a matter of high importance, I will, at the risk of being thought tedious, here take the liberty of reproducing a few extracts bearing thereon.

"A shed capable of holding a stock of say 1000 tons, will, with the ground on which it stands, probably not cost less than £1000, interest on which amount, at 7½ per cent, would be £75, which, divided by 1,000, would show that each ton of coal stocked was costing 1s. 6d. more for interest alone than the same coal laid down before the retorts for immediat use; but the wages for stocking had also to be paid at say 9d. per ton, and if a railway were used this 9d. would represent the value of a charge of 7½ per cent. on its probable cost, and the labor entailed in working it; for in the case of stores other than that in or very near the retort-house, the railway would not materially affect or cheapen the value of stocking, in as much as a railway for a store-shed would not be used throughout all the year, but only during the short period of time the stores were being filled; and further, it would cost 6d. to bring each ton of coal from this store-shed to the front of the retorts; so that these several items would together form a charge as below—

	s.	d.
Interest for use of store at per ton.....	1	6
Interest for use of railway, or to pay for manual labor to store coal at per ton.....	0	9
Cost of removal from stores at per ton.....	0	6
Together forming a charge per ton on the coal stored of.....	2	9

"But if coal is stored it is usually paid for when stocked; and if stocked, to be used six months afterwards, the interest for the use of the value of the coal, for half a year, at, say 5 per cent. per annum, has also been lost, equal to 1-40th of 20s.=6d. per ton, which, together with the previous charge of 2s. 9d., will collectively make a cost of 3s. 3d. per ton.

"The values of the proportional fall of illuminating power, and of production per ton, are tabulated below, showing the percentage of fall—a coal producing 10,000 cubic feet of 14-candle gas, at 20s. laid down, and a cannel producing 10,000 feet of 22-candle gas at 30s. per ton, being taken as the assumed standards of quality. *Coal originally producing* 10,000 *cubic feet of* 14*-candle gas, and worth* 20*s. delivered. Cannel originally producing* 10,000 *cubic feet of* 22*-candle gas, and worth* 30*s. delivered,*

Per centage of loss.	Illuminating power in Candles.	Return per ton.	Decrease of Values corresponding to Decrease of Makes and Illuminating Power.*	Value of interest and cost of stocking at 3s. 3d. per ton.	Both values added.	These values *plus* the original cost of the coal.
Loss.	Candles.	Feet.	Less than 20s s. d.	s. d.	s. d.	s. s. d.
0 per ct.	14·0	10,000	...	...	...	+ 20 = 20 0
5 "	13·3	9,500	2 8	3 3	5 11	+ 20 = 25 11
10 "	12·6	9,000	5 3	3 3	8 6	+ 20 = 28 6
15 "	11·9	8,500	7 8¾	3 3	10 11¾	+ 20 = 30 11¾
20 "	11·2	8,000	10 1½	3 3	13 4½	+ 20 = 33 4½

* The items in this column, arrived at by calculations in preceding tables in the papers from which these extracts are taken.—E. S. C.

"From this table it appears that if a coal were purchased at 20s. per ton, delivered before the retorts, which, when laid down, was capable of producing 10,000 cubic feet of 14-candle gas, and if, instead of using this coal, it were stocked to be used say six months hence; if it were then found that it had lost 5 per cent. of its illuminating and productive power, it would be worth 2s. 8d. less than its original value 20s.; but as this loss of value had to be restored by the purchase of extra quantities of cannel, it would practically have cost after this depreciation of quality was restored 5s. 11d. more than the fresh coal at 20s., and it would now have cost 25s. 11d.

"If 10 per cent. were lost it would be worth 5s. 3d. less than 20s, but would have cost 8s. 6d. more, or it had now cost 28s. 6d. as against 20s. And so on up to losses of 15 per cent. and 20 per cent., the prices per ton being raised to 30s. 11¾d. and 33s. 4½d. respectively, instead of 20s., the original cost"

Mr. Graham's figures, although perhaps not universally applicable as to the precise values given, and making allowance for the less depreciation of coals of a hard and compact structure, than of softer and more friable kinds, yet indicate what doubtless, in many cases, is a very serious aggregate loss, where coals have to be stored for winter use.

It may be asked what has this to do with the question of high or low level sites? The answer is, that as respects this country, and it is with it we are interested, it may have a great deal to do with it. Low level sites, *par excellence*, are contiguous to rivers, ice-bound for half the year, and if the only means of transit in connection with the works is by water, the winter consumption of coals must be stored with the injurious results, in a greater or less degree, so strikingly set forth in the foregoing quotations, to say nothing of the removal of residuals.

In concluding this section I desire to express my dissent from the prevalent belief in the advantages of low level sites, in respect of economy of distribution. In the distribution from works situated on about a level with the bulk of consumption, there is, for the few hours of general lighting, a higher pressure in the districts near the source of supply than is necessary, with a fair and adequate supply beyond, taking it for granted that the mains are of sufficient caliber and judiciously arranged; and with a practically perfect control over the pressures during the whole time of minimum consumption. The evil effects to the consumers in the area of excess of pressure, is easily and cheaply obviated by the use of a dry governor attached to the meter.

On the other hand, when works are situated to any considerable extent, below the level of the major part of the consumption, a little less initial pressure suffices for the supply in the evening, but with the detrimental effects to the company of an excess over the higher portions of the district continuously. It is true that valves may be inserted in the mains to diminish the difficulty, but their efficacy is restricted to the few hours of heavy consumption, outside of which time they are of no avail whatever. Apart from the expensive alternatives previously alluded to, of separate systems of mains, or outlying gasholders, the use of dry governors is the only available remedy at moderate cost, and they are extensively employed in England.

It thus seems to me that these much vaunted low level sites, in respect of distribution, are a decided mistake; also, that in the parts of this Continent in which there is a cessation of navigation in winter, the selection of a site for works on a railway, by which fresh mined coal could be obtained all the year round, although at considerably higher rates of carriage than by water during summer, is, all things considered, preferable to a site having water communication only.

RETORT-HOUSE, AND RETORT SETTINGS.

The retort-house, and the operations carried on within its walls undoubtedly stand first in importance in a gas company's business. It is there the prime article of their manufacture—the gas—is produced, and on these operations mainly depend both the quantity and quality of its productions, and also the quantity received for sale of the product from which the next largest revenue to that of the gas is derived, viz., the coke.

As respects the house itself, but little requires to be said. A good width in front of the retort-benches is desirable, especially where the coal is carted into the house. It makes the house cooler and more comfortable for the men, but like all other gains it has

its price, in the greater loss of heat by radiation from the benches, requiring to be made up by the consumption of extra fuel.

In the matter of ventilation it is hardly necessary to mention that openings in the walls, on a level with the benches, should be avoided, and that the cold external air, continuously pouring into the house should not only be above the line of the retorts, but should be controlled in quantity according to the temperature. The exceedingly chilly effect experienced by a person while standing for a few moments only in the strong indraught through a doorway opening, even when the temperature is but moderately low, enables one to form some idea of the very considerable abstraction of heat from the retort-benches, in the case of such current being continuous. This objection is referrable, of course, more particularly to winter, and is presumedly wholly inapplicable to the "Sunny South," where thorough ventilation may be expected to be a necessity, to enable the stokers to perform their exhausting labor in hot weather.

Touching the question of a single high chimney stack for each house; two or more shorter ones projecting above the roof ridge, say 15 to 20 feet; shorter ones still, either of brick or sheet iron, delivering the used furnace gases inside the roof, and each serving for one or more settings; and no chimneys at all, as I understand to be the prevailing custom in this country, I desire to speak, with some diffidence, my experience having been confined to the two first named classes, although I prefer chimneys. In cases in which coal is used as retort fuel it seems to me that high chimneys are indispensable to create such a draft as will ensure a sufficient quantity of air being drawn through the furnace to burn each of the bodies into which the coal is resolved, viz., the coke, the hydrogen, and the carbon of the gas into carbonic acid in the furnace instead of at the chimney top, and for like reason a greater furnace bar area, than where coke is used, is necessary. But in the general practice of using coke as fuel, the question of chimneys or no chimneys appears to be of less moment, so long as there is *sufficient draft for proper combustion.*

In England, so far as I am aware, the use of chimneys for retort-houses is universal. But instead of one high chimney for each house, two or more comparatively short ones (depending on the length of the house), viz., one above each barrow-way passage, from one side of the house to the other, and which cut the bench or range of arches into sections of six or eight each, is now being pretty generally adopted. Two sides of each chimney rest on the adjoining buttresses, at the end of the respective sections, on each side of the passage, and the other two sides are supported by an arch over the passage, sprung off these buttresses. This system acts exceedingly well, the main flues leading to the several chimneys taking each the spare heat from three to six beds on each side of the chimney as the case may be. The chimneys, although usually built wholly of firebrick, are but inexpensive, and are conveniently out of the way.

As an example of the working capacity of such chimneys, I may state that I have found one with a 4 ft. × 4 ft. flue, and 50 feet high, from the top of the retort-bench, give sufficient draft for 18 fires, each heating a bed of seven 10-feet long retorts, being 8-9ths of a square foot of flue area per furnace. With a greater height more flues could have been put on to it, but as it was arranged to take only eighteen fires, it was restricted to the aforesaid height.

For another house in the same works there was a circular chimney, 70 feet high from the level of the main flue, and having a 4 feet diameter flue, being slightly more than 12½ square feet in area, which took six through beds on each side of it, or 24 fires, each heating seven retorts, being. say half a square foot of area per fire, and which gave amply sufficient draft.

I have already said that the desideratum is *proper* combustion, and believing this more likely to be ensured by a chimney draft than without, I am bound to say, however unpopular such an opinion may be here, that I am on the whole in favor of chimneys.

I believe the objections to chimneys take something like these forms, that they are expensive, and are unsightly appendages to a gas works; that the fires nearest the chimney have the most draft; and, what covers all the others, that they are entirely unnecessary, as is abundantly proved by the experience of the American gas world.

The replies to these objections are, that the cost of a chimney or chimneys in the constructive account of a gas works, is such a mere bagatelle as to be undeserving of a moment's consideration, and that, at but comparatively trifling cost, they may, where thought necessary, be made so ornamental as to be the most conspicuously elegant features about the works; and that by a proper adjustment of the dampers, the beds nearest the chimney need have no more draft than those farthest off. As to the major objection, of their being unnecessary, I would like to say a few words. It is true that American experience proves that retorts can be properly heated without chimneys, but the important question is, can they be heated as economically in the expenditure of fuel as where chimneys are used?

The heat evolved in combustion is increased by its vividness, by the conversion of the whole of the carbon of the fuel into carbonic acid, instead of by a mere sluggish fire, a portion being perhaps only converted into carbonic oxide, and this completeness of combustion I believe to be more thoroughly attained by the greater draft of a chimney, of course care being taken by adjustment of the draft, that cold air shall not be drawn through the setting. It is desirable to have a surplus of draft at command, which is secured for all time by the merely nominal first cost of a chimney or chimneys.

I am under the disadvantage of not having exact information as to the average or ordinary retort fuel account of American gas works, but from what I have heard the consumption of fuel in heating the retorts is considerably in excess of similar works on the other side of the Atlantic. This I by no means attribute solely to the want of chimneys, because the arrangements of the retort settings has so much to do with a greater or less consumption of fuel, but I think it is a fair presumption that the more efficient combustion by a chimney draft may partly account for the difference.

Coming now to the very important part of the procedure of the manufacture of illuminating gas, the retort settings, I would desire to express my sense of the necessity of substantial foundations for the arches in which the retorts are set, both for the permanence of the structure and for economy of fuel. The waste of heat in raising the temperature of under percolations of water may, through insufficient drainage, be a source of considerable continuous loss. It might be thought that the heat naturally ascending from the furnace would not be likely to permeate, to any appreciable depth, through the foundation or floor of the oven, but a single example would seem to indicate that, unless means be taken to obviate it, that it will do so to a greater extent than might be expected. Upwards of twenty years ago, when superintendent of gas works in the south of England, built on the chalk formation, I had occasion to overhaul a bench of arches which gave signs of settlement. On lifting the floor of the arches they were found to be resting on powdered lime, two to three feet deep, showing that the heat had penetrated through the floor in sufficient intensity to burn the chalk into lime, a striking instance of the necessity of diverting possible sub-aqueous currents by drainage, and of the necessity of deep and solid foundations.

Respecting the number of retorts in the same arch, my experience has been that the consumption of fuel does not increase as the number of retorts. Settings of five are perhaps more generally used than any other number, but which I think might, in moderate sized works, be advantageously superseded by a greater number. It is, I believe, contended by the advocates of these settings, that as there is a less absorption of heat in carbonizing coal in fire than in six, seven or more retorts of equal capacity, that the size of the furnace and other conditions may be so adjusted that the consumption of fuel need be proportionately no more, but practically that view does not hold good. A probable reason of the relatively heavier consumption of fuel is the proportionately greater area of front wall and arch covering, and, consequently greater amount of lost heat; and the feasibility of this theory is brought home to one while standing for only a few minutes on the top of a bench of retorts in action, or even in front of the retorts, and reflecting on the enormous quantity of heat flowing continuously, day and night, from the bench. And the greater the exposed surface, in proportion to the number of retorts, the greater is the loss.

For this reason there is a considerable gain, instead of setting five retorts in two horizontal lines, the lower one consisting of three, and the upper one of two retorts, in arranging them two in width, instead of three, *i. e.*, in two tiers of two each, the fifth one being placed above, and vertically between the upper two. By this disposition an arch of about three-fourths the width required for the former arrangement suffices, not only correspondingly diminishing the radiating surface, but also having the additional advantages of economizing retort-house room; having the retorts in closer contact with the furnace heat, and presenting three vertical tiers instead of two, for the heat to rub against. For a similar reason, it is better to set a bed of three in a narrow arch, in vertical line, instead of in the form of a triange, as they usually are.

A practice that obtains, so far as I am aware, almost exclusively on this continent, in large works, is that of setting close-ended retorts, back to back, in a double-length arch, that is, with their back ends butting against a thick cross wall (in which are the vertical flues), which divides the oven into two equal lengths. Now this system I am constrained, with all due defference, to disagree with. It diminishes the length and consequent working capacity of the retorts, as compared with double-length or through ones, by the thickness of such wall, and, what is of more serious consequence, presents a face at the end of each for the accumulation of carbon, rendering its removal so difficult, that special contrivances have to be resorted to to effect it.

I do not desire to be understood as asserting that there is any less accumulation of scurf on the sides of through than there is in close-ended retorts, but there being no closed ends, the trouble is diminished to that extent, which is found to be an important advantage. Leaving the lids slightly loose for a few hours, allowing an inflow air, causes such a shrinkage of the coating on the sides, as to permit of its detachment with the scurfing bar, in long flakes, with comparative ease.

Where lumpy coal is carbonized, precluding the use of the charging scoop, through retorts may be employed in works requiring only two stokers per shift, but where scoops are used, their adoption is restricted to works large enough to require two gangs, or six men, as a minimum number in summer, the retorts being charged from both ends simultaneously.

Even in the smallest works it is desirable to be able to open the back ends of the retorts. This is accomplished by having the bench say about four feet away from the retort-house wall, and having a short mouthpiece attached to the back end of each retort. The back of the retort is formed of a half brick stack wall, the space between which and the mouthpiece lid being filled up. When the retort requires scurfing this is cleared out and the back removed, when the carbon presents a flat face all round, of the thickness of the deposit, the current of air through its retort causing such a shrinkage as to enable it to be easily removed. Or if preferred it can be burnt off, by having a spare lid, both front and back, with a segment cut off each, and turning them round as required, causing the air to rub against the side of the retort in which the openngs in the lids are. I have a strong belief that those adopting through retorts would find their advantages so decided, that they would not be likely to go back to close-ended ones.

Another aspect of this important question of retort arrangements is that of the quantity of brickwork in the setting. There are those who decry chequered supporting walls, and who affirm that they interfere with the free course of the furnace heat; that they absorb a portion of it; that they cause the retorts to crack, and I don't know what else besides. Some enthusiast, evidently of this school, not long ago set some retorts in Canada, eschewing the abominations of supporting walls, but the whole fabric tumbled to pieces in three months, as could only have been expected.

In a paper contributed to the last meeting of the British Association of Gas Managers by Mr. William Richards, the inventor of the two diaphragm dry meter, now almost exclusively made by dry meter manufacturers, on "The Theory of Retort Settings," he advocated this anti-supporting wall theory, and advanced the objections I have enumerated. To the anticipated very pertinent question of how, after the brickwork has been heated, has become saturated, so to speak, with caloric, can it absorb any more, and if it cannot, what becomes of it, always assuming a proper arrangement for its acting on the retorts, except by the retorts absorbing it, in the conversion of their contents from the solid to the gaseous state? He could only reply that there are laws connected with caloric, with which we are unacquainted, and ask in turn what becomes of the light of a lighted candle when placed under a bushel? the appropriate reply to which would be, that it would speedily "become" extinct. Well, one can only say, that the theory would seem to be rather shaky, if such is the nature of its defence. That gentleman acknowledged that retorts, as ordinarily supplied in England, would not stand without the supports he condemned, but stated, that when engineer of gas works abroad, he obtained retorts from a Belgium maker, that were so set, and lasted for years. The quality of a retort is doubtless of paramount importance, and it may be that the manufacturers are screwed down too much in price; that with a better price they could and would produce a better article; and I would say broadly, that if that could be done, it is mistaken economy on the part of gas companies not to obtain the very best that can be produced, for the sake of a little, or even a considerable, additional cost.

But general statements, such as the life of a retort, without giving its total production of gas, are often, if not misleading, at any rate very unsatisfactory. Retorts worked at a dull heat may last three or four years, and yet make no more gas than they would have done in, say two-thirds of that time, if worked at a higher heat; while the cost of labor in handling coal making not more than two-thirds of what it was capable of producing; the waste of the coal itself, in thus producing tar and oil, instead of gas; and the additional consumption of fuel, would together be very serious.

Mr. Richards (who is an able man, and quite a mechanical genius, and whose views I here consider, because they are fairly stated, and are, moreover, a fair exposition of the opinions of a class of professional brethern, in respect of these matters) exhibited the drawings, and explained the construction of a setting of six ovals, arranged in relation to each other, in the ordinary way of two vertical rows, one on each side of the furnace, each being a little from the side wall of the oven.

The bottom retorts rest each on a brickwork seating, and with a longitudinal flue, in the usual way, under it. The middle one on each side is supported by a close wall of blocks, reaching from front to back, resting on the bottom one, and the top ones are each supported by a similar close continuous wall or seating on the middle one. These walls or seatings, from being the only supports the retorts have, are necessarily of considerable width, the drawings showing them two-thirds the width of the retorts. A close ceiling of fire tiles extend from the front to within a foot of the back wall of the oven, rest on and cover the space between the two top retorts.

The furnace heat is thus enclosed in a chamber, the sides of which consist of the retorts and the close continuous walls between, and above by the close fire tile ceiling. It has thus to pass along the enclosure or chamber to the back walls; up through the foot-wide space, between the termination of the ceiling and the back wall; forward to the front wall, outside such enclosure, *i. e.*, between the retorts and the arch; down, just inside the front wall, into the flue under each bottom retort; and back through these flues to the exit flue.

This may be called the horizontal system of heating retorts, in contradistinction to the vertical system, to be presently referred to, and I have been thus particular in describing it, because, with minor variations, it is a good general example of such system; in all the modifications of which the heat is caused to travel horizontally, first to the back, then to the front, and back again, under the bottom retorts.

To here repeat what I have said elsewhere, the furnace gases, like those produced in the retorts, will pass where there is least resistance, and in the case of settings of six, where there is necessarily a considerable width between those on the one and those on the other side of the oven, the heat flows therein in an unbroken up mass, only its outsides being in contact with the sides of the retorts. In returning from the back to the front of the setting, the whole naturally keeps close up under the crown of the arch, while in the longitudinal flues under the bottoms, it is squeezed into too small a compass, such flues usually not being more than a third the width of the retorts.

That retorts so set can be sufficiently heated is true, but I think it is equally true that their heating requires an unnecessary consumption of fuel.

I may here mention in passing, that I can see no necessity for the usual practice of setting the bottom retorts away from the side walls of the oven, wasting so much space, with its attendant evils. Even in settings heated on the horizontal system it is unnecessary. It may be asked how else is the heat to get into the flues under the bottom retorts? I reply by cutting a flue way out of each side wall of the oven.

The system of heating retorts which I believe to be the best may be styled the vertical system, in which the furnace heat alternately flows up and down, through and among the retorts, having perfect freedom to pass between and surround them. The vertical system is divided into two modifications, called respectively two chambered and three chambered, which may, in a general way, be described as follows: In both, the bottom retorts rest each on a longitudinal half brick thick wall, but which does not extend quite to either the front or back wall of the oven, and in corbels projecting at intervals frome the side walls; each bottom retort being placed close to the side wall, the thickening at the mouth being let into the wall. In the former modification the oven is divided into two lengths or chambers, by a brick thick cross wall, built close round the retorts, but having suitable openings near and at its top. The furnace gases rise in the front chamber, or space between the front and division walls, striking against the retorts, and being thereby broken up, so that they spread and surround them, the middle retorts being each a few inches from the side wall, to permit of its being completely enveloped. They then pass through the openings in the division wall, and descend similarly in the back chamber, or space between the division and back walls; thence forward under each of the bottom retorts, between the side of the furnace brickwork (arranged to merely catch under the side of the retort) and the longitudinal half brick supporting wall, round the front end of same; and back again through a similar flue, formed by said longitudinal wall, and the side wall of the oven, and up the leg of an A shaped exit flue in the back wall, which joins into a single vertical flue; or into a cross flue at the back, under the bottom retorts, and up through a vertical exit flue, either in the back, or in one of the side walls of the oven. The under sides of the bottom retorts, it should be mentioned are exposed to the heat, except the narrow strip where they rest on the half brick wall.

In the other modification, instead of only one cross division wall there are two, whith divide the length of the oven into three spaces or chambers, the one described in the foregoing arrangement, or two chambered setting, being in this case, nearer the front wall, and the other having no openings in it. The play of the furnace heat is the same as in the other, this additional wall forming the back wall of the second or descending chamber, and the heat in issuing from under the bottom retorts, instead of escaping by a vertical flue in the back or side wall, ascends among the retorts in the back or third chamber, and makes its exit through an opening in the crown of the arch.

The positions of the retorts are further strengthened by arch ribs across the opening between the retorts one, one side of the oven, and the other by their being sprung off the sides of the retorts; and in beds of seven, disposed in the usual way, of one being over the furnace, there is an arch the length of the furnace, with side nostrils to protect the retort. There are also in each chamber one or more chequered walls, as they are called, being merely half brick blockings between the retorts, which, with the arched ribs, are of the greatest value in preventing pieces dropping out of the retorts, when they have been used long enough to crack. But in addition to these important purposes, this internal brickwork has the further quality of acting as reservoirs, or magazines of heat, absorbing it when there is an excess, and restoring it when there is a deficiency; and, in my opinion, if they served no other useful end would be well worth putting in, for this latter advantage alone.

Just one word more before quitting this subject, respecting the materials employed in setting the retorts. There are those who use fancy moulded blocks instead of ordinary bricks, for that purpose, which may or may not save a little in labor, but I am of opinion, that even if there be any such saving, it is more than counterbalanced by the extra cost of the blocks. With the exception of some half dozen plain fire tiles in a setting, I have never seen the need of using anything else but fire bricks, and which seem to me to be the cheapest mode of setting.

CONDENSATION.

It is now the opinion of the chemists that the pipes leading from the hydraulic mains should convey both gas and liquids, and should be prolonged as much as possible, consistent with avoiding an over-reduction of temperature; and this view is confirmed by practical experience. Keeping the gas as it leaves the hydraulic main in contact as long as possible with tar and ammoniacal liquor, is undoubtedly very effective in reducing the carbonic acid, the sulphur compounds' and napthaline, and a convenient way of effecting this is to support the pipe on the retort-house walls on brackets, leading it to and fro, with just sufficient inclination for the liquids to flow.

This alone is sufficient for winter condensation in this climate, but in summer the gas, on leaving this atmospheric condenser, should traverse a set of pipes passing backward and forward in a shallow tank of water, placed overhead, to enable all the water used on the work to be drawn from it. I find that, during the extreme heat of an American summer it is almost impossible to sufficiently reduce the temperature of the gas by means of atmospheric condensers, even when water is trickled over them, and doubtless this accords with the experience of gentlemen present. There is a good deal in the saying that gas well condensed is half purified.

WASHING AND SCRUBBING.

After leaving the condensers the gas, in my opinion, should go first through a washer and then through a scrubber, and in works of any considerable magnitude through two scrubbers. The arrangement I prefer and act on is that the washer be supplied from what has passed through the second scrubber, that the first scrubber be supplied with ammoniacal liquor, and the second one with either diluted liquor or water only, so as to absorb any ammonia that may remain in the gas; and that in each the supply be

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pumped up, and passed through the scrubber again and again, until the requisite strength, say seven to eight Twaddle, equal fourteen to sixteen ounces liquor be obtained in the first one, which, with the contents of the washer, is then run off for the sulphate of ammonia works. This arrangement is quite simple and manageable, while the cost of the little steam required in driving the pumps is practically nil.

I have the most favorable opinion of the advantages of a good washer. It removes all traces of tar, so objectionable in covering the filling of the scrubber, and preventing the gas getting in contact with the wet surfaces, on which its efficiency depends, or in getting forward to the purifiers; freely absorbs ammonia, and also carbonic acid and sulphur; and requires no attention or labor, farther than running off the strengthened charge, and refilling, as required. A form of such a vessel, possessing some novel and effective features, which I have recently devised, is to be seen in the room.

Ammoniacal liquor, strengthened by the processes just described, contains a large quantity of sulphide of ammonium, which has the capacity of combining with sulphuretted hydrogen, and, in a higher degree, with carbonic acid. And when it is borne in mind that, while every 1000 measures of crude gas from Newcastle coal contains 1½ parts of ammonia, and 8 parts of sulphuretted hydrogen, they contain no less than 25 parts of carbonic acid (and presumedly gas from American coals, always excepting Nova Scotia coal, does not differ greatly from these proportions), it will be seen how important the arresting of these impurities, particularly the carbonic acid, is in the further purification, and by means requiring practically no manual labor, and, at the same time, furnishing a valuable commodity.

PURIFIERS.

The further and final purification of the gas may be effected either wholly with lime, partly with lime and partly with oxide of iron, or with oxide only. Perhaps the best method is to have one, or, if preferred, two boxes, but not working in rotation with the others, for the absorption of the carbonic acid still left in the gas, and the others worked with oxide for the sulphuretted hydrogen. In this country, where happily the bi sulphide of carbon bugbear is unknown, the order of lime and then oxide, or *vice versa*, is of little moment.

Perhaps nothing has struck me more forcibly, in gas matters in this country, than the limited use, as I understand, of oxide of iron in purification. Its economy, as compared with lime, seems to me to be as indisputable as its freedom from the noisome effluvium of foul lime, the disgusting odor from which pervades the neighborhood of gas works, when a purifier is emptied, and may be said to be chiefly answerable for the popular prejudice against living in their neighborhood.

As to the relative economy of oxide as compared with lime, I may state that the cost for six successive years at Sydenham averaged ·34 of a penny, but say, in round figures, a half-penny, or one cent per thousand cubic feet. In that case it must be understood that the account was credited with the receipts for spent material, which is readily sold in England, when it contains about 40 to 50 per cent. of sulphur for the manufacture of sulphuric acid; and for that reason the cost is necessarily higher here, there being as yet no market for the used material.

But even at Montreal, the cost of purification last year was only 1 and 6-10ths cents, but say roundly 1¾ cents per 1000. It should however be explained that the coal used exclusively, with a percentage of Cannelton cannel, was Nova Scotian, which is so charged with pyrites as to contain at least twice or three times as much sulphur as Newcastle, or I suppose the average of American coal. In both instances the cost was doubtless considerably reduced by the previous copious washing of the gas, by which from 30 to 50 per cent of the carbonic and sulphur may be eliminated.

PHOTOMETRY;

In making photometric experiments, counterpoising the candle in a pan of the scales before lighting, warming the wick at a gas burner, so that it may attain its maximum light as soon as possible; instantly lighting it as the clock strikes; at the expiration of ten minutes (when the observations have been taken,) extinguishing it the moment the clock strikes; and then ascertaining the consumption of sperm, is a mode, I suppose, now seldom practiced. If it is so in any case, it should be abandoned, because the candle cannot at first be in a proper state of burning, and consequently the first few readings of the photometer will be much in excess of the real comparative value of the gas. "The real lighting value of a candle may be considered as the average of its light during the first ten minutes after ignition, would be undoubtedly considerably lower than the average for the whole time of its burning, it is manifestly unfair to employ the candle under the conditions mentioned."

But even the more usual practice of counterpoising the candle, or candles after attaining the maximum light, removing to the photometer, and at the end of the ten minutes extinguishing, and again removing to the scales, to ascertain the loss of sperm, may be advantageously superseded by a much simpler method. It is objectionable in there being the possibility in moving the candle or candles about, of dropping sperm and so vitiating the experiment, and of entailing too much trouble in manipulating with fractional parts of grains in weighing. The more cumbersome the experiment, the more seldom is the photometer room likely to be visited, simplicity in this, as in other apparatus, and experiments, being a desideratum. I would therefore eschew all such grand sounding complications, as electric clocks, electric-magnetic thermometers etc., which in my opinion in the practice of photometry, are entirely unnecessary.

The instrument I prefer is what is known as the Letheby Bunsen photometer, those I use having certain improvements made by Mr. Hartley of Messrs. Allen Wright & Co., of London. The bar is 60 inches in length, carrying a saddle slide provided with four rollers to ensue easy motion, and which support an improved disc shade with cylindrical ends and a suitable opening in front, fitted with reflectors. There is the usual experimental wet meter, and a delicate wet governor, the pipe from which to the burner being furnished with a micrometer cock. There is also a black wooden screen each, behind both the burner and candles, and a similar screen near each end of the bar, interposed between the burner, and candles respectively, and the disc, each having a central hole for the rays of light to pass through to the disc. The screens behind the burner, and candles, prevent the rays of light from their respective flames, falling upon objects, from which they would be likely to be reflected back to the disc, while the perforated ones in front of the respective lights, shield the operators eyes from the direct rays of the flames, so that being in comparative darkness, he is better able to decide upon the illumination of the sides of the disc.

Another recommendation, is the employment of two candles instead of one, or rather half candles, the one burning from the smaller and the other from the thicker end, by which any variation in burning, or in the intensity or power of their respective lights, are mutually corrected. A stronger standard light too is obtained, rendering easier the fixing of the point of equality, and enabling the operator to work over a wider scale, *i. e.* over divisions nearer the center of the scale, thus compensating (except in testing very rich gas) for the closer divisions than on a 100 inch bar.

But perhaps the most important improvement as regards both facility and accuracy, is that of weighing the candles by a fixed sensitive scale, *while burning, and in a proper position for experiments.* By this means all trouble of moving them, and of manipulating with grains and fractional parts, is obviated. The candles having attained their maximum light; the gas burning at the rate of exactly 5 cubic feet per hour; and the candles nearly counterpoised; the minute hand of the clock is noted, and the seconds beats counted on, until from burning, the candles became lighter, and the pointer of the balance reaches the center of the index, at which moment a 40 grain weight is dropped into the pan under the candles, and the observations proceeded with. Before the expiration of the ten minutes, the position of the clock is again noted, and the seconds counted on, until the balance turns, and its pointer again reaches the center of the index.

It will be thus seen, that instead of the weight of sperm burnt in ten minutes, as in the usual way of correction, in this case it is the length of time occupied in burning 40 grains, (20 grs × 2 candles). By the former method, it is a variable consumption of sperm in a given time; in the latter it is a given consumption of sperm in a variable time.

But mark the ease of the correction for any deviation from the standard consumption. It is only necessary to multiply the average observed illuminating power of the gas, by the standard time of the consumption of the 40 grams of sperm, viz., 10 minutes or 600 seconds, and divide the product by the number of seconds it took the 40 grains to burn, the quotient being the corrected illuminating power of the gas.

That this principle is correct, a moment's reflection will show, because if the candles are burning at less than the standard rate, the observed will be in excess of the actual illuminating power of the gas, because it is compared with a light less than the standard light. But the candles burning at a slower rate than two grains each per minute, will have taken longer than the standard time of 600 seconds, and as the standard is the constant multiplied, and the actual time the divisor, and the latter in such case being greater than the forms, the excess of the observed illuminating power is reduced, and corrected. On the other hand, should the consumption of the candles be slightly in excess of the standard, the time of consuming 40 grains wil be less than 600 seconds, and the observed illuminating power of the gas, from being tested against a light of greater intensity than the standard, will be less than its actual illuminating power, but the divisor in this case being less than the multiplier, the quotient will give the increased and corrected illuminating power.

I have alluded to a clock, and it will be understood that I refer to a substantially made, and accurate, pendulum clock, hung on the wall, giving seconds dead beats, and striking each minute, after giving five seconds warning. With such a clock the eyes of the operator, are occupied only with the meter in obtaining the standard consumption of the gas, and the candles balance in counterpoising, the ears taking the time from the distinct dead beats of the clock and the minutes strokes.

The arrangement I prefer, is to have the meter, and candles balance, at the right hand end of the photometer bar, and near the wall of the room to the right of the operator, the clock being hung on the wall, and in a line with where the operator stands. By this arrangement it is only necessary to note on paper, the time when the weight is dropped into the candles pan of the balance, leaving the mind quite free with respect to noting the time when the 40 grains are burnt, because while keeping the eyes on the balance pointer, when it begins to swing, the pendulum can be stopped by the operators hand, without shifting his position, the moment the balance is equipoised.

With these appliances, I believe greater accuracy is secured, than by the other processes, the operatives being at any rate simplified. I have not alluded to making corrections for temperature, and pressure, because in the ordinary way of testing, I think it unnecessary, the consumers burning the gas under the same atmospheric condition.

In conclusion, I beg to apologize, for what I fear many will think, the unwarrantable length of these lucubrations. I can but assure the meeting, that when I began, I had no intention of extending these observations to such an inordinate length, and my excuse must be that of the lady, who apologized for writing a long letter, for want of time to write a shorter one.

[To be continued.]

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—ED.

Some Explanation in Regard to Poor Gas in Poughkeepsie.

NEW YORK, October 23, 1876.

Mr. Editor: In your Journal of the 2nd inst. you quoted a paragraph from the Poughkeepsie *Daily Eagle* of September 18th, to the effect that the gas furnished by the Citizens Gas Company was of a very poor quality the previous night; that in fact it had been so for the previous two or three nights. The cause of it they did not learn.

I hope you will allow a brief explanation.

1st. That company has been running about sixteen months, and has made 18,000,000 feet of gas, which averaged seventeen candles during that period. Of course "poor gas" would be quickly noticed, although as good as many other places are frequently furnished with.

2nd. The cause of it was simply this. When crude petroleum went up to 15½ cents, they filled their oil tank with naphtha, at a cost, delivered there, of eight cents. Their engineer, Mr. Harris, deeming the heats of the oil bench required for naphtha to be less than for crude oil, directed the men to watch until the flow of the naphtha began, and then to let down the heat a little on that bench, In his absence, from the 15th to the 19th of September, the men let down the heats too much. Hence the results noticed. But on his return Mr. Harris quickly rectified the matter, and there has been no trouble whatever since that occurrence.

H. P. ALLEN.

Ventilation of House-Sewers.

To the Editor of the American Architect and Building News.

Dear Sir; I desire to report, for the information of the profession, the good results obtained from a plan just carried into effect, for the more perfect ventilation of house sewers. It has been my custom for some years past, to continue the vertical waste-pipes of all water-closets through to the roof; but in addition to this, in the case referred to, the waste-pipes of all baths, sinks, basins, etc., have also been extended upward and through the roof, forming a direct outlet to each line of pipes throughout the entire building. The usual traps are not omitted; and a main trap is placed at the exit of the main line from the building, immediately beyond which is a vertical outlet carried up through the wall above the roof. This system of ventilation relieves all the traps from any pressure of gas, as well as thoroughly ventilating the entire lines. The building being a very large apartment dwelling in New York City, with more than a hundred outlets for waste, where gas or stenches usually enter, the result seems to be not only an unusual freedom from smell, but, I believe, an entire absence of it. The water-closets are each provided with a double pipe, one connecting below the trap, and the other directly with the receiver, between the main trap and pan. This also appears to do its work properly. Perhaps this system is not new, though it is the first building in which I have attempted so thorough a precaution.

B.

Manufacture of Dynamite.

M. Sobrero, the discoverer of nitro-glycerine, has communicated to the Académie des Sciences the results of some experiments, which he thinks may be useful to manufacturers of dynamite.

While acknowledging the importance of M. Noble's idea of giving to nitro-gylcerine the consistency of a solid body by causing it to be absorbed by a silicious substance, so as to be more easily employed in mines. M. Sobrero has always been struck with the frequent occurrence of explosions in dynamite factories. He has often though that these accidents, the details of which are very imperfectly known, may be caused by the manipulations which take place, either in preparing the paste of nitro-glycerine and the absorbent substance, or in moulding or compressing the paste for giving it the form of cartridges. Compression and friction against hard substances are so many causes which easily bring about an explosion of nitro-glycerine.

It seemed to M. Sobrero that these causes of danger might be avoided by modifying the manufacture of dynamite in the following manner:—The silicious substances, of the nature of *Kiesel-guhr*, &c., although only slightly plastic, are capable of being moulded after moistening with a little water, and take a consistency which is not inferior to that of dynamite cartridges. He made some cylindrical cakes with Santa Fiora fossil meal, which after being dried at 100° Cent. (212° Fahr.), to get rid of the water, were plunged vertically into the nitro-glycerine, so as to become saturated therewith.

The experiments to determine the quantity of nitro-glycerine which cakes were capable of absorbing, were not made with the liquid itself for fear of accident, but with olive oil, which is nearly of the same consistency.

The author is convinced that dynamite with 75 per cent. of explosive substance, as is generally required, may readily be obtained by his process; while, at the same time, all violent pressure or friction is avoided. The cakes, after leaving the bath of nitro-glycerine, have only to be placed to drain, and then wrapped in paper, when they are ready for use.—*Jour. Society of Arts.*

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

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NOVEMBER 2, 1876.

☞ All communications will receive particular attention

	Capital.	Par.	Bid.	Asked.
Gas. Co.'s of N. Y. City.				
Harlem	$1,850,000	50	103	110
Manhattan	4,000,000	50	240	245
Metropolitan	2,500,000	100	140	145
" Scrip	$1,000,000	...	102	—
" Bonds	500,000	1000	104	—
Mutual	5,000,000	100	110	111x
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	135	140
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	10	...
Bonds	30,000		90	
Paclede, St Louis Mo	1,200,000	100	100	110
Peoples, Jersey City		...	125	135
Leoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	99	100
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y.		100	50	60
Richmond Co., S. I.	300,000	...	97	100
Woonsocket, R. I.	150,000	100	100	...
Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri	600,000	50	—	100
Stillwater, Minn	50,000	50	—	26
Suburban, W'stch'str	390,000	50	—	100
Saugerties, N. Y.	15,000	100	110	115
Troy, Citizens	600,000	100	—	100
Central, Westchester	466,000	50	95	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	180	185
Citizens	1,200,000	20	93	95
" Scrip	320,000	1000	95	100
Peoples	1,000,000	10	45	50
" Bonds	$ 325,000	...	...	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	70	75
Nassau	1,000,000	25	75	80
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	130	135
" Scrip		...	98	100
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	—	90
Baltimore, Md.	2,000,000	100	150	170
" Ctfs., gold	1,000,000		105	—
Bayonne, N. J.		100		90
Brockport, N. Y.	25,000	100	...	80
Citizens, Newark	918,000	50	95	100
" " Ctfs.	53,000	—	—	—
" " Bds.	124,000	—	—	—
Derby of Conn.	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind.		100	...	—
Hannibal, Mo.	100,000	100	95	100
Hartford, Conn.	700,000	25	152	—
Hempstead, L.	25,000	100	...	—
Jersey City	386,000	20	160	—

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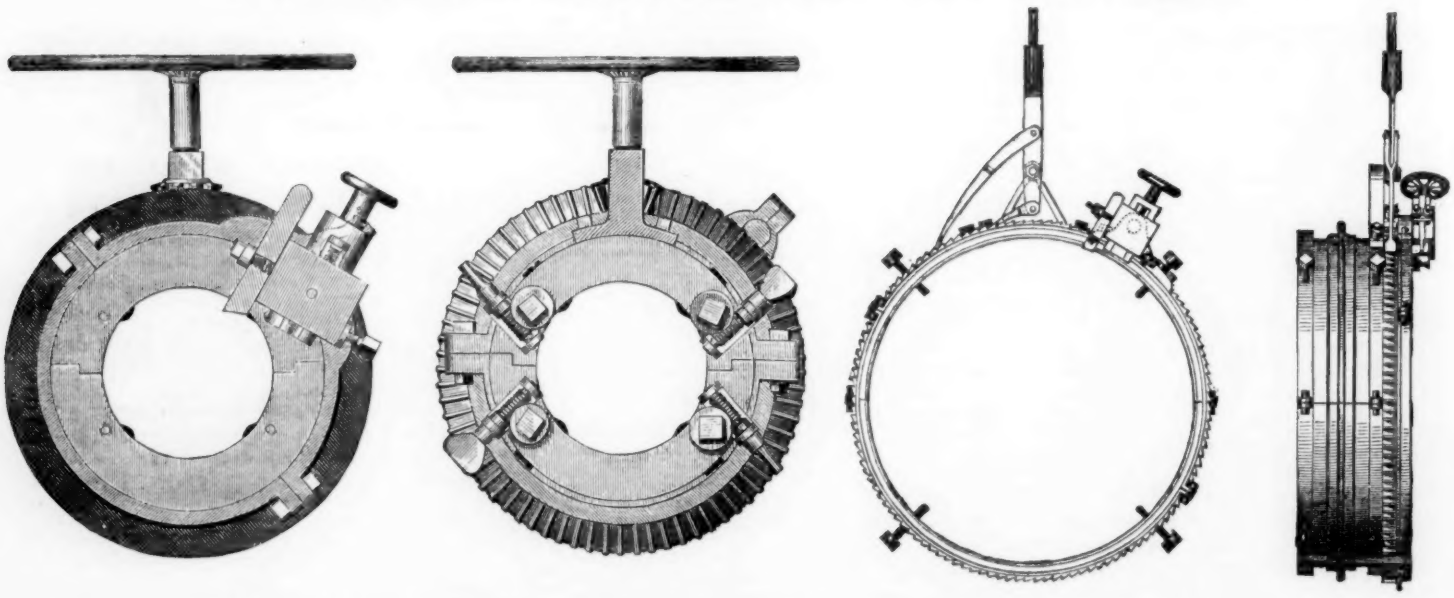

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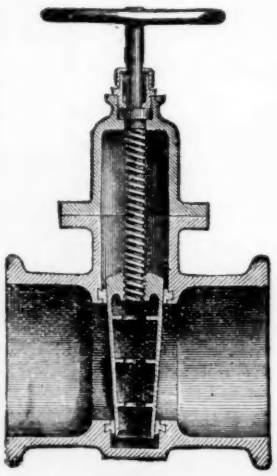

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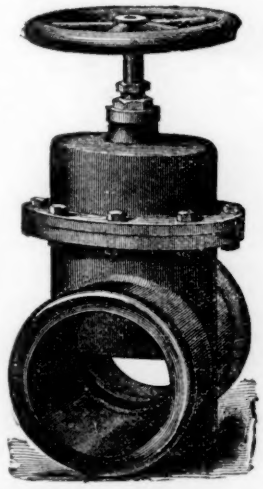

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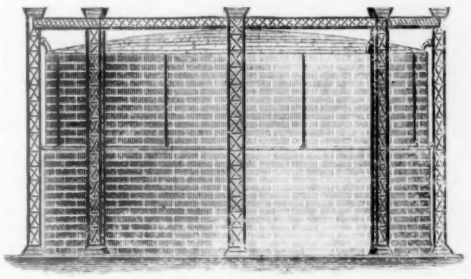

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Volatile Matter.	Coke.	Per cent. of Ash in Coal.	Per cent. of Ash in Coke.	Sulphur in Coke.	Sulphur in Ootl.	Sulphur in Volatile Matter.	Specif. Gravity. Coal.	Specif. Gravity. Gas.
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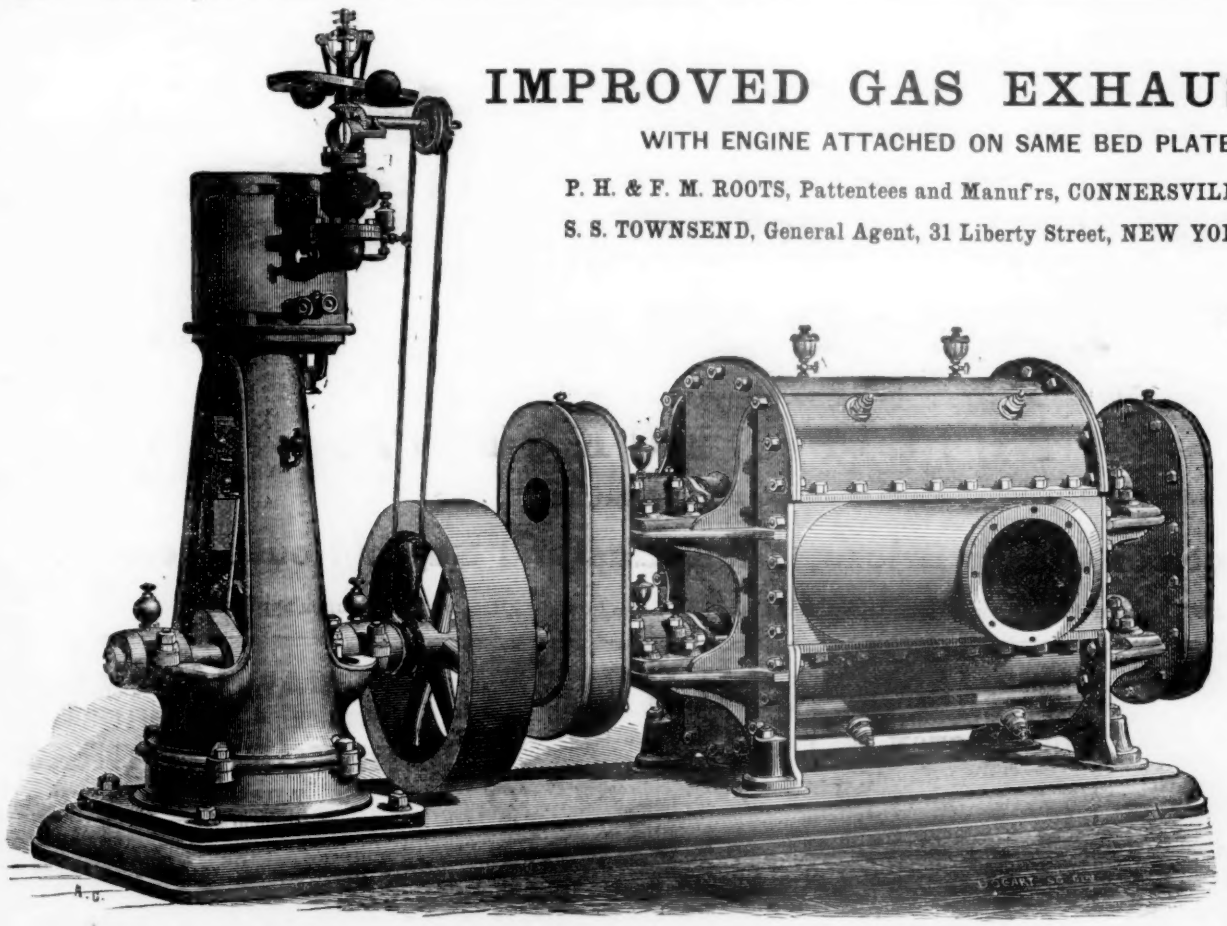

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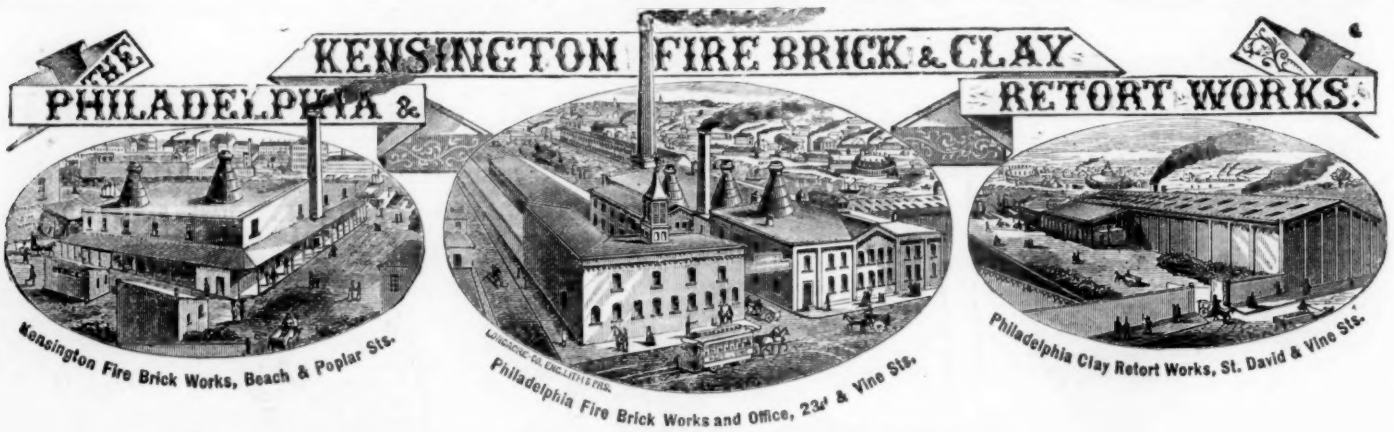
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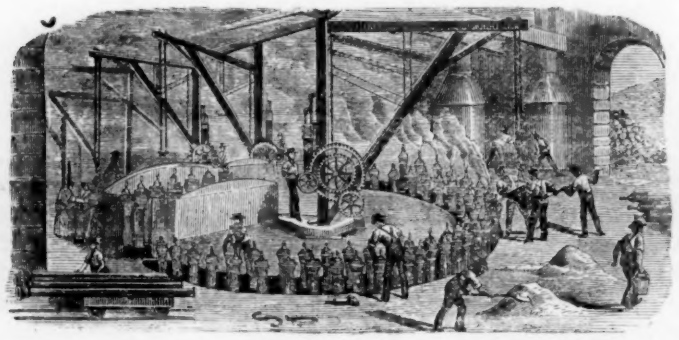

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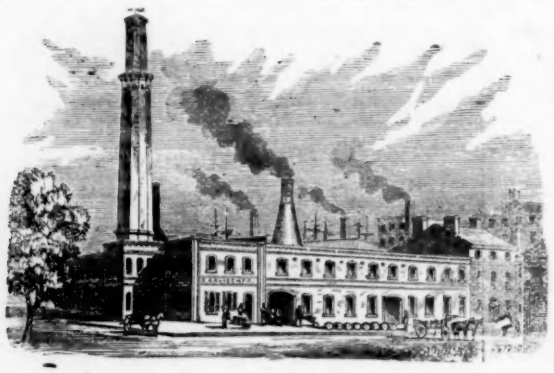

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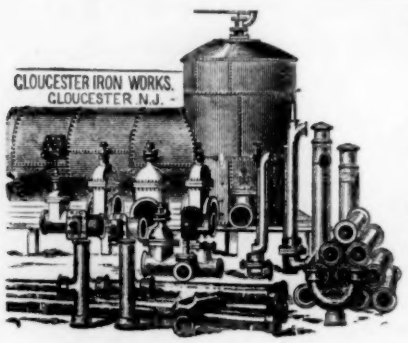

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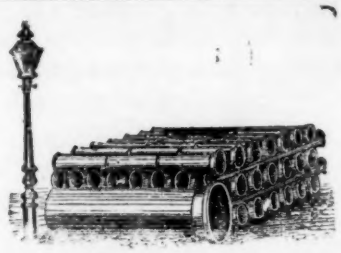

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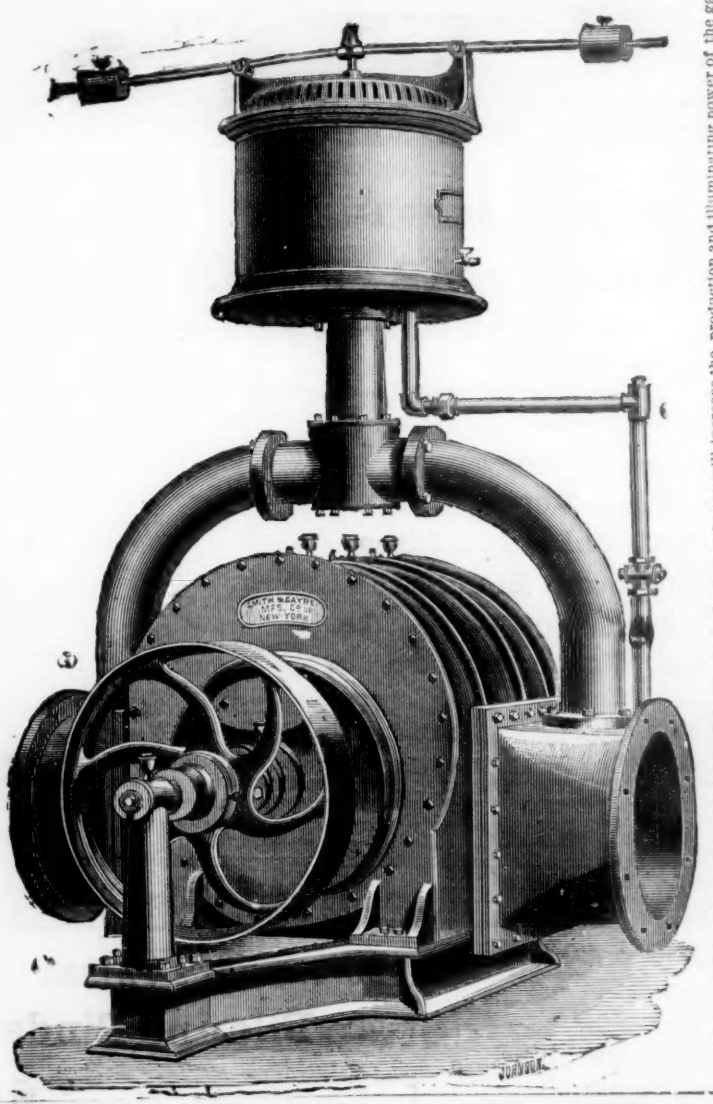

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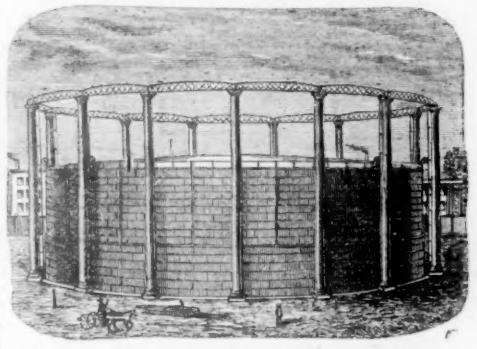

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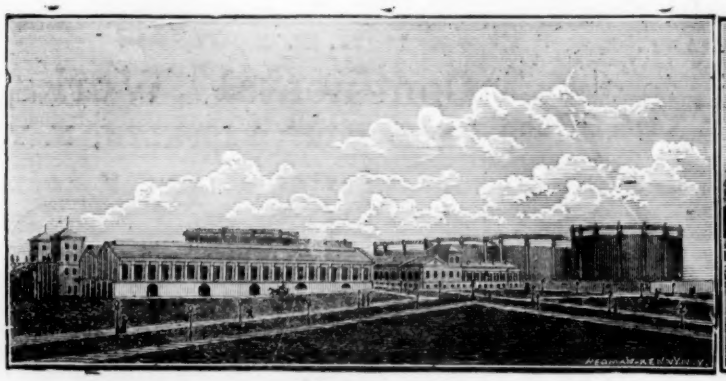

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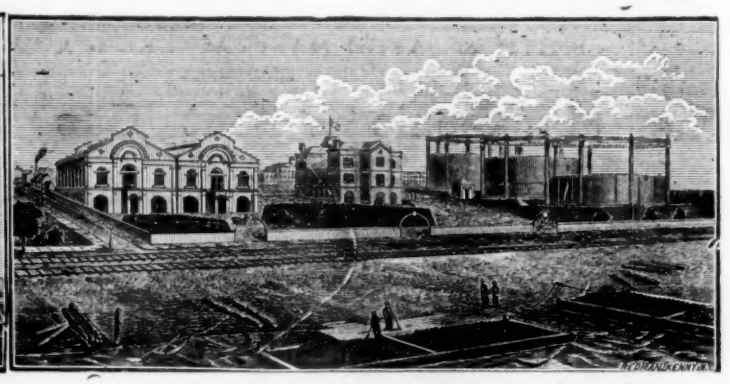

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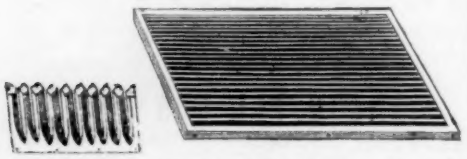

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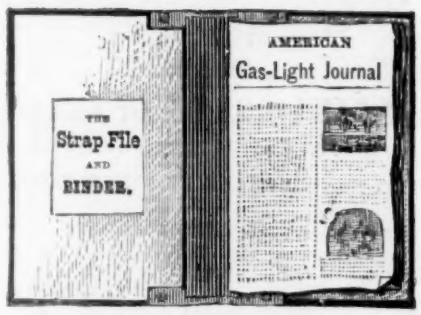

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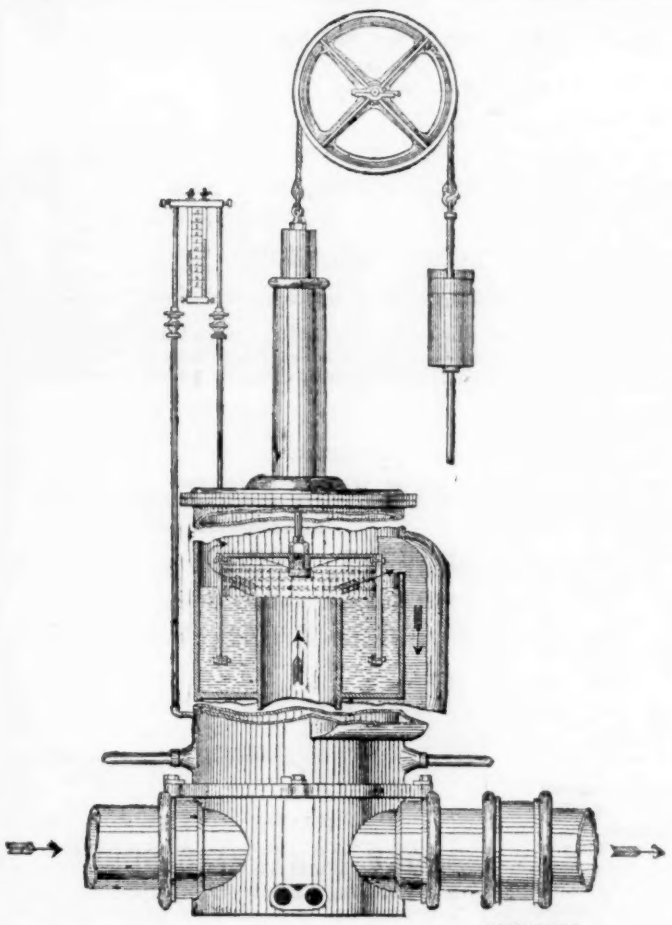

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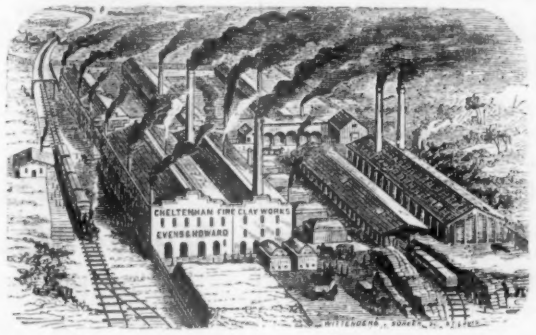

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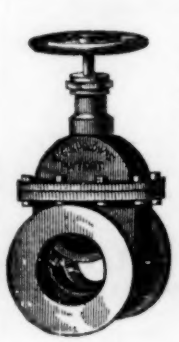

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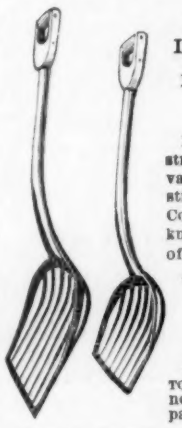

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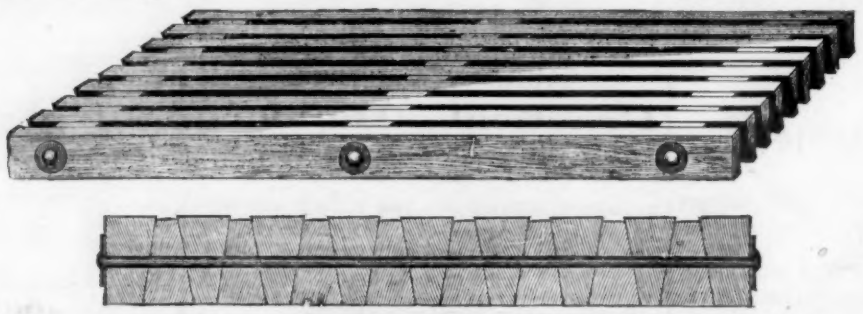

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Elmira Gas Company, New York.
Erie Gas Company, Pa.
Columbus Gas-Light Company, Ohio,
Westchester Gas-Light Company, N. Y.
Santa Cruz Gas Company, Cal.
Lawrence Gas-Light Company, Kansas
Salem Gas Company, N. J.
Indiana Gas-Light Company, Pa.
Peoria Gas Company, Ill.
Montclair Gas Company, N. J.
Williamsport Gas Company, Pa.
Wooster Gas-Light Company, Ohio.

Augusta Gas-Light Company, Ga.
Huntsville Gas Company, Ga.
Chattanooga Gas Company Tenn.
Murfreesboro Gas Company, Tenn.
Hagerstown Gas-Light Company, Md.
Hanover Gas Company, Pa.
Easton Gas Company, Pa.
Uniontown Gas-Light Company, Pa.
Coatesville Gas-Light Company, Pa.
Houston, Gas Company, Texas.
Wilkesbarre Gas Company, La.
Middletown Gas Company, New York
Washington Gas-Light Company, Pa.
Princeton Gas-Light Company, N. J.
Newark Gas Company, Ohio.
Pontiac Gas-Light Company, Mich.
And numerous other Companies.